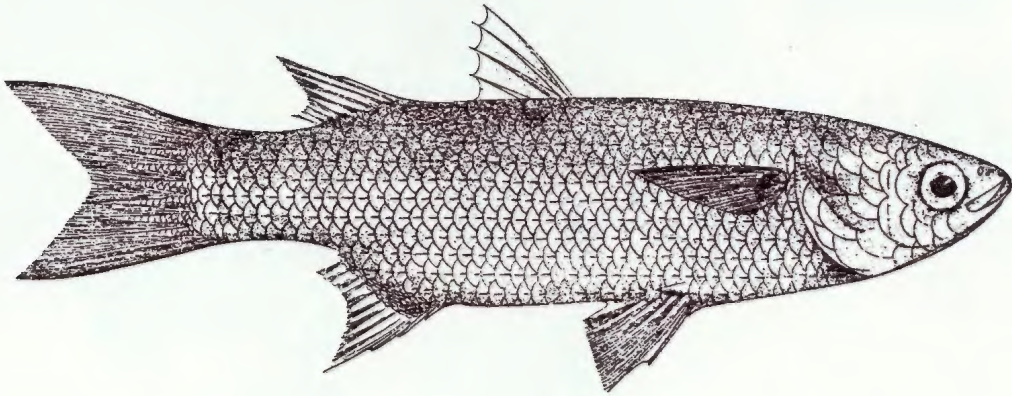


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# THE MUGILIDAE OF THE WORLD

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Of the 280 specific names applied to Mugilidae 62 are accepted as valid, with 18 classified as species inquerenda. 14 of the 40 defined genera are recognised. Only one new species, *Liza mandapamensis* is described. □ *Mugilidae*, review, taxonomy.

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280 specific names have been bestowed on mullets of the Family Mugilidae. Many of these have been recognised as synonyms in regional reviews over the past 120 years by Day (1876) and Pillay (1962) for India, Jordan & Swain (1884) for the Americas, Athanassopoulos (1919) and Popov (1930) for Europe, Weber & de Beaufort (1922) for Indonesia, Fowler (1928a, 1931, 1934) for Oceania, Borcea (1934) for the Black Sea, Roxas (1934) for the Philippines, Smith (1935) for South Africa, Fowler (1936), Cadenat (1954) and Poll (1959) for west Africa, Thomson (1954) for Australia and Trewavas & Ingham (1972) for the NE Atlantic and the Mediterranean. Reviews of the genera of mullets have been offered by Jordan & Evermann (1917), Mohr (1927), Popov (1931), Schultz (1946), Smith (1948) and Thomson (1954). However there has been no published review of the genera and species of the Mugilidae as a whole since Günther (1861b). Susan Ingham completed a review in 1952 which remains unpublished. I was unaware of this when I commenced this review in 1972, and although Dr Trewavas drew Ingham's manuscript to my attention I deliberately did not refer to it until I had made my own judgments. Apart from the status of *Valamugil* our conclusions are very similar, though often based on different criteria, and I acknowledge that Ingham's review was completed before I had commenced this work. I have adopted her system of counting gill rakers and added the counts of rakers on the lower arm, but otherwise features listed are those which I adopted from the literature or had elucidated myself. Involvement in University administration and some government committees prevented my earlier completion of the review.

## DIAGNOSTIC CHARACTERS

Mugilid species are remarkably uniform in external form and scarcely less so in internal anat-

omy. The main evolutionary diversification has occurred in the mouth and associated anatomy as demonstrated by Schultz (1946). Apart from such commonly used attributes as the counts of scales, fin spines and fin rays and the measurement of body proportions, the features of diagnostic value include the structure of the scales, the relative position of the nostrils, the number and form of the gill rakers, the form of the preorbital, the relative length of the paired fins and of their axillary scales and the position of origin of the various fins, the presence or absence of the 'adipose eyelid' and the degree of its intrusion over the eye, as well as the number of pyloric caeca and the relative length of the intestine.

**Jaws.** Jaw structure is basically percoid, distinguished by the premaxillary having short pedicels and a shaft which, in the Agonostominae, is widest at its midlength and pointed at its distal end, whereas in the Mugilinae the shaft is broadest at the blade-like distal end. Within the Mugilinae the edge of the premaxillae remains more or less parallel with the line of the mouth gape in some genera, but in others it curves down behind the corner of the mouth.

The maxilla lies behind the premaxilla and at its upper end attaches to the ethmoid by a ligament. The degree of protrusibility of the mouth is largely governed by the degree of mobility of the maxillae, for they are locked to the premaxillary pedicels via the maxillary processes which also fuse in the midline. When the mouth is closed the premaxillary pedicels retreat under the nasal bones.

A tendon from the superficial portion of the adductor mandibulae is inserted on a flange on the anterior face of the maxillary shaft. The curvature of the maxillary is sufficient to allow the tendon to pass transversely upwards to the anterior face of the shaft in the Agonostominae and most of the Mugilinae but in *Chelon*, *Liza*, *Oedalechilus* and

*Crenimugil* where the mouth gape is short and the tendon almost horizontal, the maxilla has developed an outward curve over the lower fifth of its length to provide an unimpeded line of action for the tendon. In these genera the end of the premaxilla also curves behind the mouth corner.

In Agonostominae the shaft of the maxilla is almost straight, bending slightly, rather than curving, at the level of the flange. In Mugilinae the line of the maxillary shaft is almost straight when viewed laterally and curves slightly and gradually in anterior view. In *Chelon*, *Liza*, *Oedalechilus* and *Crenimugil* the maxillary shaft curves in 2 planes in its lowermost  $\frac{1}{4}$ , but outwards and backwards from the initial outward curve at the flange. Maxillae of *Valamugil* and *Myxus* differ from these general types. That of *Myxus* is broad, curving backwards but scarcely outwards. It is thus intermediate between Agonostominae and the *Mugil* group. However, the premaxilla of *Myxus* is typical of Agonostominae. The maxilla of *Valamugil* indicates a transition between the *Mugil* and *Liza* groups of Mugilinae, with the maxilla curving down behind the mouth in one plane only, rather than the S-shape typical of *Liza* and its relatives. Two conditions have been confused in the literature under the general description of 'maxilla visible below and behind the corner of the mouth when the mouth is closed'. What are visible are pads of tissue, the maxilla being submerged in the pad to varying depths. In most species to which the description has been applied there are 2 pads lying close together. The posterior, and usually larger pad, is that over the end of the maxilla. In front of it is another pad which overlies the end of the tendon to the corner of the mouth. In *Valamugil* only the pad over the tendon is visible. In some species, notably of *V. engeli*, this pad is often hidden by a cutaneous flap growing from behind the base of the lip.

The lower jaw presents 2 features of generic significance. In more primitive genera the coronoid process of the dentary bone is massive and mounts from the general shaft of the dentary well in front of the mouth corner. In other genera this process is slender and rises from the shaft behind the mouth corner. In *Cestraeus* the dentary is extended posteriorly and ventrally to form a deeply undercut flange which is covered by a fleshy lobe. The other diagnostic feature of the lower jaw is the degree of development of the symphyseal knob. In the Agonostominae there is either no central knob rising above the lower lip (*Agonostomus* spp.) or there is only a broad low mound. Among the Mugilinae, *Chaenomugil* has only a low mound, but in all other genera there is a high

symphyseal knob with almost vertical sides, sometimes divided into lateral halves by a distinct groove.

**Lips.** Skin covering the edges of the jaws are described as lips. The whole of the upper lip of Mugilidae is delimited by a groove, but the analogous groove behind the lower lip is incomplete and its relative length is a useful diagnostic character. The upper lip covers the anterior part of the premaxillae. In the majority of mullet the upper lip is highest medially, narrowing gradually to the corners of the mouth. But in a few species, e.g. *Mugil thoburni*, and *Crenimugil* and *Oedalechilus* spp., lip height is very little different, if at all, laterally. In *M. bananensis* the lip increases markedly in height at the lateral ends.

The description 'thick' has been used in two different senses in the literature when describing the lip. It has been used to describe either the distance from front to rear or the vertical spread of the lip. I use the term to describe the relative distance the upper lip projects in front of the anterior edge of the head. The vertical spread is called lip height. In some species the mandibular angle changes from acute to obtuse with age (Thomson, 1954). As the head broadens the shape of the upper lip may change but this is marked only in *Valamugil seheli* and its close relatives.

In *Chelon*, *Crenimugil* and *Oedalechilus* the lower part of the upper lip is raised into papillae whose ultimate shape is of specific significance. They are epidermal structures without any connection to the teeth. In young specimens of most species of these genera and in adult *Chelon labrosus* small setiform teeth are present as well as the papillae. The papillae are not evident in young fry until a length of about 60mm SL and there appears to be considerable variation in the length at which they become visible (Trewavas & Ingham, 1972). The lower lips of Agonostominae and of *Crenimugil* and *Oedalechilus* are thick and deep. The rest of the Mugilinae have thin chisel-shaped lower lips which project almost horizontally forward. Like the upper lips, the lower lips of *Crenimugil*, *Chelon* and *Oedalechilus* are ornamented either with papillae or crenulations. The lower lip is permanently folded down in *Cestraeus* spp. The lip of *Mugil thoburni* has also been described as folded down, but of the 14 specimens available for study only one had the lower lip completely folded; in 4 the lip was not curled down at all and in the remainder sections of varying length on one or both sides were curled. Occasional individuals of other species have been observed with lips curled down, including *Mugil curema*, *M.*

*curvidens* and juvenile *M. cephalus*. Probably mullet with thin-edged lower lips may be able to curl the lower lip voluntarily during life and appearance after death or fixing depends upon muscular contraction. Generally the lower lip is entire, i.e. the anterior edge continues in the same plane across the symphyseal region. In several genera the external edge of the lip curves up around an external groove under the symphysis. Such a lip is 'not entire'. The lower lip of *Liza* and of a few other species have a row or rows of papillae near the base of the lip.

**Preorbital.** In the Agonostominae the preorbital is almost quadrangular; in Mugilinae roughly triangular. The external surface of the preorbital is flat in *Agonostomus*, *Joturus*, *Cestraeus* and *Chaenomugil*. In other genera a ridge, originating at the base of the posteriormost serra of its lower edge runs roughly parallel with the front edge of the preorbital, forming a scoop-shaped trough along the anterior portion of the preorbital. In life this trough is filled with either flesh or adipose tissue. The topographical anterior edge of the preorbital is regarded as the ventral edge by those concerned with the homologies of bones and the topographical ventral edge is the posterior. To avoid confusion the term 'front edge' is used here for the edge nearest the upper lip and 'lower edge' for that extending between lip and eye. This terminology is not apt in the case of aged specimens of *Joturus* where, because of differential growth of the front edge the point that is normally the rearmost on the lower edge comes to lie in front of the original anterior corner and the normal lower edge comes to lie over the hindmost part of the front edge. The lower edge of the preorbital is serrate in all but a few species. In a few the serrae have become sharp spines. In most species the front edge also is serrate, but remains smooth in some. In genera with maxillae that do not bend down behind the mouth corner, the front edge of the preorbital is either straight or gently curving. In those genera where the maxilla bends down behind the mouth corner the front edge of the preorbital is notched to accommodate the mouth corner. In most species this notch persists, but in some it tends to fill with age. In more primitive species the preorbital is broad and fills the space between the lip and eye; but in more advanced species the preorbital is narrow; in some it fills only part of the space between eye and lip.

**Nostrils.** The nostrils lie in characteristic positions in each species. In some, the nostrils are

nearer each other than the posterior is to the eye or the anterior to the lip; in others one or both may be closer to the appropriate feature than to the other nostril. The posterior nostril usually reaches just about the level of the upper rim of the eye, but in a few species is higher. There is one species, *Rhinomugil squamipinnis* (Swainson), in which the posterior nostril is displaced to the level of the lower half of the eye.

**Teeth.** Mullet teeth are small and usually described as either ciliate or setiform. In Agonostominae teeth are sessile, of normal teleost type, though small, borne directly on the premaxilla and dentary in bands of varying width. In form they are either incisor-like or are wide-fronted, flattened antero-posteriorly, and are often multicuspoid. In the Mugilinae the teeth are minute and labial, situated at the extreme edge of the lips, on the distal ends of flexible strands in the lip tissue which proximally join to the dentary or to the premaxilla. They vary from setiform or ciliiform to flattened teeth, sometimes with multiple cusps. Ciliiform teeth are differentiated from setiform teeth by being finer and lacking the dark core typical of setiform teeth.

**Scales.** Both cycloid and ctenoid scales are found in Mugilidae. Some variation in attribution occurs in the literature. Jacot (1920), Kesteven (1942) and Thomon (1954) described the scales of *Mugil cephalus* as ctenoid. Schultz (1946) and Smith (1949) called them cycloid. On most scales of *M. cephalus* and related species, a row or two of weak ctenii mark the posterior margin of the scale. But the ctenii laid down earlier do not project; their former site being indicated by a patterning of the surface of the posterior quadrant which has been interpreted either as the ctenii submerged in the tissue of the scale or as their bases after the points have sloughed or have been worn off. This type of scale is distinguished as 'pavement ctenoid'.

Two types of scale have been described as 'cycloid' in mugilids. One type has a firm rounded posterior edge and is commonly found on the flanks of certain species of *Liza* and *Mugil*. Juveniles of *Valamugil* and *Crenimugil* have similar scales but in late juveniles and adults the scales develop a flexible membranous margin posteriorly which can be seen to be fimbriate in well-preserved scales.

A proportion of scales are provided with pits or grooves known as mucus canals. These first be-



come apparent as almost circular depressions in fish about 40mm in length. This simple condition is retained in the scales of adult Agonostominae. In *Myxus* spp. and in less specialised *Liza*, such as *L. abu*, a short canal runs forward from the original pit. In other genera and in more specialised *Liza* the canal may be much longer but does not penetrate the segment of the scales posterior to the nucleus to any extent except in *Valamugil* where in some species it reaches the posterior edge of the membranous margin. In some species a scale may have Y-shaped, T-shaped, double or even triple canals. This has been taken further in *Liza saliens* and *L. dumerili* where the dorsal scales on the head and on the back, anterior to the first dorsal fin have 2 canals in early juveniles, but by the time the fish is adult the scales are multicanalicate, having between 7 and 10 canals.

Immediately above the insertion of the pectoral fin some species have an axillary process, usually referred to as the axillary scale, although >one scale may be involved in its structure. The axillary scale is lacking in the Agonostominae. It is strongly developed in *Mugil*, *Valamugil* and *Crenimugil*; some species of *Liza* have a moderate pectoral axillary scale but in most *Liza* species it is reduced to a misshapen rudiment or is completely lacking.

*Intestine.* In Agonostominae the intestine is relatively short, lying in only 3 loops in the abdominal cavity and measuring 1.5-2.0 times standard length of the fish. In more primitive Mugilinae, such as *Myxus*, the coiling has increased and the relative length is 1.5-5 times standard length. In *Mugil* the intestine is elaborately coiled and is 3-5 times standard length. The intestine is even longer in other mugiline genera attaining 6-7 times the standard length in *Chelon labrosus*.

*Stomach.* The stomach is a simple U-shaped sac with uniformly thin walls in the Agonostominae other than *Aldrichetta*. In typical Mugilinae the stomach is divisible into a thin-walled cardiac crop and a very thick-walled biconical pyloric gizzard. In this respect *Myxus elongatus*, *M. petardi* and *Aldrichetta forsteri* are intermediate, having weakly developed gizzards.

*Pyloric caeca.* The primitive number of 2 pyloric caeca is found throughout the Agonostominae and in *Mugil*, *Rhinomugil*, *Sicamugil*, *Chaenomugil* and *Myxus* (except for *Myxus capensis*). In other genera the number of caeca varies (2-22), though more usually 5-9. Daget & Ittis (1963) reported a quite wide variation in the number of py-

loric caeca within the few species they examined, but in my experience, including the species examined by those authors, the number has been fairly constant within a species.

**JUVENILE MULLET.** The characters used in keys and detailed descriptions can be used confidently only with adult mullet and with juveniles whose length is greater than 60mm SL. Even at this length some characters, such as the extension of the adipose tissue over the eye in some species has not reached the adult state. At about 60mm SL a degree of metamorphosis takes place involving not only the transformation of the third supporting element of the anal fin to a spine in the Mugilinae and a few Agonostominae, but also in a considerable rearrangement of the mouth parts. In the young (*Querimana*) stages the mouth gape is steeply inclined but later becomes less steep and almost horizontal in some genera. The nostrils are usually above the level of the eye in young mullet but descend below the level of the upper rim of the eye in most species at metamorphosis. The dorsal fins are more crowded in young mullet, the tip of the recumbent first dorsal spine almost touching the origin of the second dorsal fin and the tip of the second dorsal fin almost reaching the base of the caudal fin. Except for species with a unique attribute, such as an unusually great fin-ray count, it is extremely difficult to distinguish the species of small mullet.

## METHODS

Most of the measurements are standard in systematic studies, but due to peculiarities of mullet some non-standard measurement have been introduced and to facilitate presentation some non-standard abbreviations have been used.

*Scales.* The number of scales in the lateral series (L1) has been counted from the scale immediately above the insertion of the pectoral fin (i.e. just behind the head) to the caudal flexure. The 5-8 scales of intermediate size between the flexure and the very small scales covering the caudal fin have not been counted. The transverse scale count (tr) is the number of scales between the origin of the first dorsal fin and the origin of the pelvic fin. (Some authors have made their lateral count from the base of the second dorsal fin to the base of the anal fin.) The peduncle scale count (ped.) is the number of scales between the mid-dorsal and mid-ventral lines down one side of the caudal peduncle, but omitting any median scales if present.

*Body proportions.* All length measurements were taken between parallels except for the estimation of the position of the origin of the first dorsal fin with respect to the tip of the snout and the base of the caudal fin for which dividers were used to hasten the procedure. Dividers were also used to measure the interorbital, width of the head, body depth, depth of the caudal peduncle, height of the upper lip, length of the lower lip groove and position of the nostrils as well as lengths of the axillary scales of the pectoral and pelvic fins. The standard length (SL) was measured from the tip of the snout (which was taken to be the anterior-most point on the upper lip in those species where the lip is terminal) to the caudal flexure which is distinguishable by flexing the tail, even in those species where it is not readily apparent by inspection. Caudal flexure was also taken as the caudal base for determining relative position of the origin of the first dorsal fin.

*Mouth gape.* The mouth gape was recorded as the ratio of mouth width to mouth length (MW/ML). Distances were measured between parallels, mouth width from mouth corner to mouth corner, length from the anterior tip of the lip to the posterior corner of the mouth opening. A number of other authors, notably Trewavas & Ingham (1972) have measured mouth length to the end of the maxilla. The actual gape is preferable because the extension of the jaw behind the mouth corner is very variable, being very short in some species and up to 1/3 jaw length in others.

*Gill rakers.* The system of categorisation devised by Ingham was based on the number of rakers on the lower arm of the gill arch, coupled with calculations of the length of the raker at or nearest to the ceratobranchial joint relative to both the longest of the gill filaments and to the length of the gill arch. I have added the count of the rakers on the upper gill arch and in some instances extended the range of counts on the lower arch.

The gillrakers are counted on the first gill arch because the rakers are longer and hence more discernible than on the other arches and they lack the spicules which serve to interlock the rakers with those of the other arches. Six categories of rakers can be distinguished among Mugilidae. In defining the types the following terminology has been adopted from Ingham's unpublished manuscript.

Short: the longest rakers are only 1/2 the length of the longest gill filaments and c.1/4 the length of the lower arm of the gill arch.

Long: the longest rakers are distinctly >1/2 length of the gill filaments, but markedly < twice

the length of the filaments and c.1/3 length of the lower arm of the gill arch; Very long: the longest rakers are at least twice as long as the longest gill filaments and c.1/2 length of the lower arm of the gill arch.

Type 1: fringes short, coarse and widely spaced; rakers short and coarse. This type of raker resembles the condition in Atherinidae and generalised percoids.

Type 2: fringes long and close-set; rakers short and close-set;

Type 3: fringes long, coarse and wide-set; rakers short or long;

Type 4: fringes long, coarse, close-set; rakers short or long;

Type 5: fringes long, fine and close-set, of a feathery appearance; rakers long;

Type 6: fringes very long and close-set; rakers very long.

**ABBREVIATIONS.** For convenience and brevity certain abbreviations have been used in the descriptions of genera and particularly of species. A = anal fin; the number of spines are indicated by Roman numerals and the number of branched rays by Arabic. D<sub>1</sub> = first dorsal fin: Roman numerals indicate the number of spines. D<sub>2</sub> = second dorsal fin; the small Roman numerals indicate the number of unbranched rays, the Arabic numerals, the number of branched rays. D<sub>1</sub> Sc = the number of scales between the operculum and the vertical from the origin of the first dorsal fin. D<sub>2</sub> Sc = the number of scales between the operculum and the vertical from the origin of the second dorsal fin.

L1 = the number of scales in the longitudinal series, counted from the scale immediately above the insertion of the pectoral fin (this is usually the scale immediately above the edge of the operculum) to the caudal flexure. ML = length of the mouth gape measured from the snout tip to the line joining the two corners of the mouth gape. MW = width of the mouth measured in a direct line from mouth corner to mouth corner.

P = Pectoral fin; the accompanying number indicates the number of rays in the fin. pect. sc. = the scale in the longitudinal series reached by the tip of the pectoral fin when laid back. ped. = the number of vertical rows of scales down one side of the caudal peduncle, excluding any median scales.

SL = standard length, measured between verticals from the snout tip and the caudal flexure.

sp.1, sp.2, sp.3, sp.4 = the first to fourth spines in the first dorsal fin.

tr = the number of scales in a transverse series counted from the origin of the first dorsal fin to the insertion of the pelvic fin.

**LOCATION OF SPECIMENS.** The museum collection in which each specimen is preserved is indicated by the following abbreviations: AM = Australian Museum, Sydney; BMNH = British Museum (Natural History), London; BPBM = Bernice P. Bishop Museum, Hawaii; IM = Indian Museum, Calcutta; LA = Laboratoire Arago, Banyuls-sur-mer; MNHN = Museum National d'Histoire Naturelle, Paris; NM = Natal Museum, Durban; NHM = Naturhistorisches Museum, Vienna; QM = Queensland Museum, Brisbane; RMNH = Rijksmuseum van natuurlijke Historie, Leyden; SAM = South African Museum, Cape Town; USNM = United States National Museum, Washington; WAM = Western Australian Museum, Perth; ZIZM = Zoologisches Institut und Zoologisches Museum, Hamburg.

**DATA RECORDED.** Synonymies include only those references in which sufficient description is included to be reasonably confident that the specimens were correctly attributed. A few references are included in the synonymies because they provide novel combinations of generic and trivial names. Counts of the caudal rays are not given because examination of young fishes consistently gave higher counts than are recorded in the literature. In post-juvenile mullet the small outer caudal rays are almost impossible to detect without tedious dissection. The biometrical data for the species are presented in tables as appendices. I find it a far more useful tool for comparing characteristics than embedding them in the descriptive text. The lengths recorded for museum specimens are mm SL.

## SYSTEMATICS

Two editions of Valenciennes, 1836 were published with differing pagination. Pagination of the 2nd edition is shown throughout in brackets.

### MUGILIFORMES Family MUGILIDAE

**DIAGNOSIS.** Pelvic bones connected to the postcleithra by a ligament; vertebrae 24 (rare variants to 26); 2 separate dorsal fins, the anterior with 4 spines, the posterior with 1 unbranched ray (often called a spine) and 6-10, usually 8, branched rays; anal fins with 2 or 3 spines and 8-12 rays; pelvic fin with a spine and 5 rays; teeth either sessile or labial.

**REMARKS.** Jordan & Evermann (1896) distinguished the Mugilinae and Agonostominae. Their criteria, based on the American species, were the presence or absence of sessile teeth, the degree of complexity of the stomach and the shape of the lower jaw. Only the first of these holds on a world wide basis, but the subfamily distinction is realistic as a more detailed examination reveals a number of consistent differences.

### Subfamily AGONOSTOMINAE

1. Teeth sessile, inside the lip; 2. superior pharyngeals covered with small teeth; 3. gill rakers short; 4. preorbital flat, without a ridge; 5. some genera (*Agonostomus* and *Joturus*) with only 2 anal spines, followed by an unbranched ray in the adults; the unbranched ray becoming a spine in the adults of other genera; 6. interorbital convexly arched, head narrow; 7. stomach U-shaped with uniformly thin walls; 8. intestine relatively short, <2.6 times SL; 9. symphyseal knob either absent or a broad low mound.

**GENERA.** There are 32 nominal genera of Mugilidae (excluding fossil forms) (Table 1). Only 14 genera are here recognised as valid.

### KEY TO THE GENERA OF AGONOSTOMINAE

- |  |       |                    |
|--|-------|--------------------|
| 1. Snout overhanging upper lip                           | ..... | <i>Joturus</i>     |
| Upper lip not overhung by snout                          | ..... | 2                  |
| 2(1). 2 anal spines in adults; interorbital high, convex | ..... | <i>Agonostomus</i> |
| 3 anal spines in adult; interorbital low,                | ..... |                    |
| almost flat.   | ..... | 3                  |
| 3(2). Free-ending fleshy lobes between lower jaws        | ..... | <i>Castulus</i>    |
| No such fleshy lobes                                     | ..... | <i>Altrichetta</i> |

### *Agonostomus* Bennett, 1831

*Agonostomus* Bennett, 1831: 166

**TYPE SPECIES.** *Agonostomus telfairii* Bennett, 1831.

*Dajaus* Valenciennes, 1836: 164(116), pl. 316. Type species: *Mugil monticola* Bancroft, 1836.

*Nestis* Valenciennes, 1836: 167(117), pl. 317. Type species: *Nestis cyprinoides* Valenciennes, 1836 by subsequent designation of Jordan 1919: 185. *Neomugil* Vaillant, 1894: 72; type species: *Neomugil digueti* Vaillant, 1894.

**DISTRIBUTION.** W Indian Ocean, Central America, Caribbean.

**DIAGNOSIS.** Interorbital high, convex, less so in early juveniles. Mouth gape oblique, less so in large fish; mid-gape at mid-eye level in small

TABLE 1. The nominal genera of Mugilidae and their generic identity.

Nominal genus	Author Date	Type Species	Assigned Genus
1. <i>Mugil</i>	Linnaeus 1758	<i>M. cephalus</i> Linnaeus	<i>Mugil</i>
2. <i>Chelon</i>	Artedi 1793	<i>M. chelo</i> Cuvier	<i>Chelon</i>
3. <i>Cephalus</i>	Lacépède 1800	<i>M. cephalus</i> Linnaeus	<i>Mugil</i>
4. <i>Agonostomus</i>	Bennett 1831	<i>A. telfairii</i> Bennett	<i>Agonostomus</i>
5. <i>Cestraeus</i>	Valenciennes 1836	<i>C. plicatilis</i> Valenciennes	<i>Cestraeus</i>
6. <i>Dajaus</i>	Valenciennes 1836	<i>M. monticola</i> Bancroft	<i>Agonostomus</i>
7. <i>Nestis</i>	Valenciennes 1836	<i>N. cyprinoides</i> Valenciennes	<i>Agonostomus</i>
8. <i>Arnion</i>	Gistel 1848	<i>M. cephalus</i> Linnaeus	<i>Mugil</i>
9. <i>Ello</i>	Gistel 1848	<i>M. cephalus</i> Linnaeus	<i>Mugil</i>
10. <i>Joturus</i>	Poey 1860	<i>J. pichardi</i> Poey	<i>Joturus</i>
11. <i>Myxus</i>	Günther 1861b	<i>Myxus elongatus</i> Günther	<i>Myxus</i>
12. <i>Chaenomugil</i>	Gill 1863	<i>Mugil proboscideus</i> Günther	<i>Chaenomugil</i>
13. <i>Rhinomugil</i>	Gill 1863	<i>M. corsula</i> Hamilton Buchanan	<i>Rhinomugil</i>
14. <i>Gonostomyxus</i>	MacDonald 1869	<i>G. loa-loa</i> MacDonald	<i>Cestraeus</i>
15. <i>Neomyxus</i>	Steindachner 1878	<i>Myxus sclateri</i> MacDonald	<i>Chaenomugil</i>
16. <i>Querimana</i>	Jordan & Gilbert 1883b	<i>Myxus harengus</i> Günther	<i>Mugil</i>
17. <i>Aeschrichthys</i>	Macleay 1884a	<i>A. goldiei</i> Macleay	<i>Cestraeus</i>
18. <i>Liza</i>	Jordan & Swain 1884	<i>Mugil capito</i> Cuvier	<i>Liza</i>
19. <i>Trachystoma</i>	Ogilby 1888	<i>T. multidens</i> Ogilby	<i>Myxus</i>
20. <i>Neomugil</i>	Vaillant 1894	<i>N. digueti</i> Vaillant	<i>Agonostomus</i>
21. <i>Oedalechilus</i>	Fowler 1903	<i>Mugil labeo</i> Cuvier	<i>Oedalechilus</i>
22. <i>Squalomugil</i>	Ogilby 1908	<i>M. nasutus</i> De Vis	<i>Rhinomugil</i>
23. <i>Xenorhynchichthys</i>	Regan 1908	<i>Joturus stipes</i> Jordan & Gilbert	<i>Joturus</i>
24. <i>Ellochelon</i>	Whitley 1930	<i>Mugil vaigiensis</i> Q & G	<i>Liza</i>
25. <i>Protomugil</i>	Popov 1930	<i>Mugil saliens</i> Risso	<i>Liza</i>
26. <i>Sicamugil</i>	Fowler 1939b	<i>Mugil hamiltoni</i> Day	<i>Sicamugil</i>
27. <i>Gracilimugil</i>	Whitley 1941	<i>Mugil ramsayi</i> Macleay	<i>Liza</i>
28. <i>Moolgarda</i>	Whitley 1945	<i>Moolgarda pura</i> Whitley	<i>Liza</i>
29. <i>Planiliza</i>	Whitley 1945	<i>Moolgarda ordensis</i> Whitley	<i>Liza</i>
30. <i>Aldrichetta</i>	Whitley 1945	<i>Agonostomus forsteri</i> Val.	<i>Aldrichetta</i>
31. <i>Xenomugil</i>	Schultz 1946	<i>Mugil thoburni</i> Jordan & Starks	<i>Mugil</i>
32. <i>Crenimugil</i>	Schultz 1946	<i>Mugil crenilabis</i> Forsskal	<i>Crenimugil</i>
33. <i>Heteromugil</i>	Schultz 1946	<i>Mugil tricuspidens</i> Smith	<i>Liza</i>
34. <i>Oxymugil</i>	Whitley 1948	<i>Mugil acutus</i> Valenciennes	<i>Myxus</i>
35. <i>Pteromugil</i>	Smith 1948	<i>Mugil diadema</i> Gilchrist & Thompson	<i>Liza</i>
36. <i>Strializa</i>	Smith 1948	<i>Mugil canaliculatus</i> Smith	<i>Liza</i>
37. <i>Valamugil</i>	Smith 1948	<i>Mugil sehili</i> Smith	<i>Valamugil</i>
38. <i>Plicomugil</i>	Schultz 1953	<i>Mugil labrosus</i> Val.	<i>Oedalechilus</i>
39. <i>Osteomugil</i>	Luther 1977	<i>Mugil cunnesius</i> Val.	<i>Valamugil</i>

fish, dropping to lower iris in large fish; mouth corner at level of lower rim of eye in small fish, dropping to well below eye level in large; mouth corner on vertical between posterior nostril and eye in small fish, moving to or behind anterior rim of eye in large fish; upper jaw end on line of

gape, lying on vertical from anterior rim of eye in small fish, under anterior half of eye in large fish; upper lip thick, terminal height at mid-gape more than half eye diameter; lower lip thick, not turned down, entire, recessed slightly behind upper lip; lips without external papillae or crenulations; lip



groove  $>2/3$  lip length; no symphysial knob; no fleshy lobes externally between lower jaws.

Maxilla straight, not curving down behind mouth corner, its tendon flange  $1/3$  or slightly more from upper end; maxilla pad sometimes visible as oval patch above premaxillae, but not visible below and behind mouth corner; coronoid process of dentary massive, rising well in front of mouth corner; mandibular angle acute.

Without labial teeth; sessile teeth in several rows, inner rows multicuspid in some species; wide gape between teeth at symphysis; teeth on vomer, pterygoids, palatines and tongue; tongue flat, with short free anterior tip; no adipose tissue on face; preorbital massive, flat, without folds or ridges, not notched; nostrils nearer each other than to lip or eye; posterior nostril nearer eye than anterior to lip; in adult eye half its own diameter below dorsal head contour; opercular opening reaching below eye; gill rakers type 1.

Upper insertion of pectoral fin at level of upper rim of pupil, without elongate axillary scale; first dorsal fin origin nearer snout tip than to caudal base; second dorsal fin origin variously from just behind vertical from origin of anal fin to  $1/3$  along anal fin base; 2 anal spines in adults and young; scales ctenoid; no opercular spine; caudal fin forked. Stomach without a gizzard; 2 pyloric caeca; intestine with only 3 loops, its length not more than twice SL.

**DISCUSSION.** Valenciennes (1836) in ignorance of Bennett's (1831) description of *Agonostomus telfairii* described 2 species of *Nestis* from Mauritius and a species of *Dajaus* from the West Indies. Günther (1861b) revived *Agonostomus*, including therein *Dajaus*, *Cestraeus* and *Agonostomus* as well as *Mugil forsteri* Valenciennes. *Cestraeus* and *M. forsteri* have not been considered congeneric with *Agonostomus* by more recent workers. Criteria used by Valenciennes to distinguish his 2 genera are features which differ with age or size. The geographic separation of the SW Indian Ocean and Caribbean species must raise doubts about their congeneric status. But close examination and comparison of specimens confirms the similarity of their features. This is a primitive genus; extant species are probably widely separated survivors of a once more widely distributed genus. The absence of a snout overhanging the mouth distinguishes *Agonostomus* from *Joturus*. *Cestraeus* possesses fleshy lobes externally between the rami of the lower jaw. The 3 anal spines in all but the young querimana stage marks off *Aldrichetta forsteri* and the Mugilinae from *Agonostomus*.

#### KEY TO THE SPECIES OF *AGONOSTOMUS*

1. Mid-height of upper lip 20-22% HL; upper jaw end at vertical from anterior rim of eye (SW Indian Ocean) . . . . . *catalai* Pellegrin
- Mid-height of upper lip  $< 16\%$  HL; upper jaw end behind vertical from anterior rim of eye. . . . . 2
- 2(1). Eleven scale rows down side of caudal peduncle; second dorsal fin origin at scale 23 (SW Indian Ocean) . . . . . *telfairii* Bennett
- Nine scale rows down side of peduncle; second dorsal fin origin at scale 27 (Pacific and Atlantic coasts of Mexico, southern USA, Columbia, Venezuela, Caribbean) . . . . . *monticola* Bancroft

#### *Agonostomus catalai* Pellegrin, 1932

*Agonostomus telfairii* var. *catalai* Pellegrin, 1932: 424, Mananano, Madagascar; 1933: 84, fig. 99, Mananano, Madagascar.

*Agonostomus catalai* Pellegrin, 1935: 72, rivers of Madagascar.

**HOLOTYPE.** Mananano, Madagascar, freshwater at 100m altitude, coll. R. Catala, MNHN 32-162, 130mm SL, examined.

**MATERIAL EXAMINED.** Holotype and 3 specimens: 130-198mm SL, from Madagascar and Anjuan. BMNH: 1865.9.21.4-5, 168 & 198mm, Anjuan.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A II 10, P 17, L<sub>1</sub> 42-44, tr. 12-13, ped. 11, pect. sc. 9-10; D<sub>1</sub> sc. 10, D<sub>2</sub> sc. 23. Scales with short mucus canals. Body robust, head bluntly rounded, scale-free to between posterior nostril and anterior rim of eye. Upper lip height almost equal to eye diameter; median upper edge of lip expanded, filling marked concavity in snout. Anterior mandibular pores large, second pair bordering anterior end of lip groove. Teeth unicuspid, incisor-like, slightly curved, pointed, scarcely emergent in lower jaw. Tongue without median ridge. Mouth corner on vertical between posterior nostril and eye; tip of upper jaw slightly below level of mouth corner and on vertical from anterior rim of eye. Preorbital filling space between lip and eye, reaching mid-eye level, well below line joining midpoints of posterior and anterior nostrils; lower edge reaching below lower rim of eye. Posterior nostrils reaching above level of upper rim of eye; anterior nostrils wholly within vertical span of posterior nostrils; wide cutaneous rim around anterior nostrils.

Pectoral fin reaching anterior  $1/2$  of eye when laid forward, not quite to vertical from first dorsal fin origin and  $1/3$ - $1/2$  along pelvic fin (not reaching the end of the pelvic spine) when laid back. Pelvic fin origin nearer vertical from first dorsal fin origin than to vertical from pectoral fin origin; its tip just reaching behind vertical from sp. 4 of first dorsal fin. Pelvic axillary scale reaching  $1/2$  along pelvic spine. Sp. 1 of first dorsal fin longer

TABLE 2. Biometrics of *Agonostomus* spp. D = body depth; ED = Eye diameter; FES = serrae on front edge of preorbital; GR = number of gill rakers; HL = head length; HW = head width; IO = Interorbital; LES = serrae on lower edge of preorbital; LL = Lower lip; ML = mouth gape length; MW = mouth gape width; PB = pectoral fin base; Ped = peduncle depth; PL = pectoral fin length; SL = standard length; SnL = snout length; TR = Tooth rows; UL = upper lip; ULH = Upper lip height; VL = pelvic fin length; VAx = length of pelvic fin axillary scale.

Species	<i>A. catalai</i>	<i>A. telfairii</i>	<i>A. monticola</i>
Scale radii	9-10	8-12	9-11
Depth (%SL)	23.7-25.7	25.2-26.0	22.6-26.3
HL (%SL)	24.0-27.3	22.4-25.0	24.7-27.0
HW (%HL)	64.0-67.0	64.0-66.0	67.0-70.0
IO (%HL)	45.9-49.3	45.0-48.8	31.5-38.5
ED (%HL)	20.8-25.8	26.0-28.3	22.4-31.5
SnL (%HL)	28.2-30.2	24.0-25.0	23.5-25.5
ULH (%HL)	20.0-22.0	10.0-15.0	9.5-13.9
MW/ML	1.45-1.75	1.4-1.7	1.1-1.8
PL (%HL)	80.0	81.8-89.0	66.0-75.3
PB (%PL)	28.3-31.2	30.2-32.0	31.5-36.0
VL (%PL)	88.0-90.0	89.0-98.0	79.0-96.0
VAx (%VL)	32.0-33.0	33.0	30.0-35.0
Ped (%D)	46.0-47.5	48.5-55.0	44.0-46.5
TR (UL)	7-8	3-8	6-10
TR (LL)	1	3-5	5-12
LES	9-11	10-16	5-15
FES	4-8	4-10	5-6
GR	27-32/34-42	20-26/26-42	8-12/16-23

than sp. 2; sp. 4 short, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical quarter along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins lightly scaled anteriorly.

DISTRIBUTION. Madagascar and Comoro Islands.

REMARKS. *A. catalai* is very similar to the other Indian Ocean species *A. telfairii*, and may be an extreme variant of that species. However the few museum specimens attributed to *A. catalai* exhibit constant differences from *A. telfairii* of the same length. The upper lip of *A. catalai* is higher, there is only one row of teeth in the lower jaw, the upper end of the preorbital is lower on the face, the pelvic fin differs in the relative position of its

origin, the head is relatively short and the gill raker counts differ. Pellegrin (1933) described *A. telfairii* var. *catalai* as having A III 8, evidently counting the first unbranched anal ray as a spine. The type specimen has 9 branching rays, not 8 or a formula of A II 10.

### *Agonostomus monticola* (Bancroft, 1836)

- Mugil monticola* Bancroft, 1836: 367, pl. 36, Jamaica.  
*Dajaus monticola* Valenciennes, 1836: 164(116), pl. 316, Antilles, San Domingo, Puerto Rico; Kner & Steindachner, 1865: 8, New Granada.  
*Agonostoma monticola* Günther, 1861b: 464, Barbados, Mexico, Jamaica; 1869: 444, Mexico.  
*Agonostomus monticola* Jordan & Evermann, 1896: 819, West Indies, central Mexico, Vera Cruz; 1902: 254, Puerto Rico; Jordan & Rutter 1898: 98, Jamaica; Evermann & Marsh, 1902: 114, fig, Puerto Rico; Fowler, 1903: 748, San Domingo; Regan, 1907a: 66, central America; Schultz, 1949: 110, Venezuela; Suttkus 1956: 43, Louisiana.  
*Mugil irretitus* Gosse, 1851: 84, Jamaica.  
*Agonostoma microps* Günther, 1861b: 462, West Indies; 1869: 444, pl 60, fig.1, West Indies.  
*Agonostomus microps* Jordan & Evermann, 1896: 820, West Indies, central America; Regan, 1907a: 69, central America.  
*Agonostoma nasutum* Günther, 1861b: 463, River at San Geronimo, Guatemala; 1869: 444, pl. 70, fig. 2, central America.  
*Agonostomus nasutus* Jordan & Culver, 1895: 424, Sinaloa; Rutter, 1896: 263, Cape San Lucas, Mexico; Jordan & Evermann, 1896: 819, Pacific and Atlantic coasts of central America; Regan, 1907a: 68, pl. 10, fig. 4, Guatemala.  
*Dajaus nasutus* Kner & Steindachner, 1865: 7 Panama, west coast.  
*Agonostoma percoides* Günther, 1861b: 464, San Domingo, Jamaica, West Indies.  
*Agonostomus percoides* Jordan & Evermann, 1896: 819, San Domingo; Regan, 1907a: 69, San Domingo.  
*Dajaus elongatus* Kner & Steindachner, 1865: 6, pl.1, fig.2, New Granada.  
*Neomugil digueti* Vaillant, 1894: 72, Baja California, freshwater near La Paz.  
*Agonostomus digueti* Schultz, 1946: 390, Baja California.  
*Agonostomus salvini* Regan, 1907a: 68, pl. 11, fig. 2, Guatemala; 1907b: 65, Rio Nacasil, Guatemala.  
*Agonostomus macracanthus* Regan, 1907a: 69, pl. 11, fig.1, Guatemala; 1907b: 65, Rio Guacalate, Guatemala.  
*Joturus daguae* Eigenmann, 1917: 681, Rio Dagua, Columbia.  
*Agonostoma squamipinne* Mohr, 1927: 178, fig. 1, Puerto Rico.  
*Agonostomus hancocki* Seale, 1932: 467, Galapagos Islands, freshwater.

TYPE. None. Type locality, Jamaica.

MATERIAL EXAMINED. 123 specimens, 77-198mm SL (including the types of *A. percoides*, *A. microps*, *A. macracanthus*, *A. salvini*, *A. squamipinne* and *N. digueti*) BMNH: 1847.27.59, 58mm, holotype of *M. irretitus*, Jamaica, Gosse; 1848.1.12.1083, 130mm, syntype of *A. percoides*, Jamaica, Parnell; 1850.6.7.16, 115mm, syntype of *A. percoides*, San Domingo, Cuming; 1861.11.7.2, syntype of *A. percoides*, West Indies Medical Officers, Fort Pitt; 1855.12.26.639-40, 133 & 260mm, syntypes of *A. microps*, locality unknown, pres. Zoological Society;

1861.9.12.14, 190mm, holotype of *A. nasutus*, Guatemala, Owen; 1864.1.26.361-2 123 & 172mm syntypes of *A. macracanthus*, R. Guacalate, Guatemala Salvin; 1875.6.9.3-4, 127-215mm, 5 syntypes of *A. salvini*, Rio. Nacari, Guatemala, Salvin; 1848.1.12.1084-5, 118 & 127mm, Jamaica; 1848.1.12.1090 125mm, Jamaica; 1848.1.12.1095, 699mm, Jamaica; 1850.7.27.3, 186mm, Barbados; 1855.9.19.210, 190mm, locality unknown; 1860.6.22, 104mm, Mexico; 1863.8.7.164, 72mm, St Croix, Leeward Islands; 1864.1.26.230, 273mm, Rio Montezem, Baja California; 1866.1.22.78-80, 3 spec. 134-153mm, Dominica; 1866.6.7.1-2, 137 & 148mm, Barbados 1880.9.7.21-2, 67mm Southern Mexico; 1890.11.23.28, 112mm, Richmond R., St Vincent; 1890.11.23.33-6, 4 spec. 87-140mm, Fitzhugh R., St Vincent; 1890.11.23.37, 109mm, Chateaubelair R., St Vincent; 1891.5.16.12-14, 3 spec. 90-137mm, Dominica; 1891.5.12.43-51, 9 spec. 95-117mm, St Vincent; 1892.9.5.69, 173mm, Rio de Masazota, Mexico, west coast; 1895.5.27.184-5, 48 & 64mm Mazatlan, Mexico; 1897.7.23.117-8, 8 spec. 76-154mm, Trinidad, 1899.3.15.18-20, 3 spec. 60-200mm, Rio el Paso Real, Puerto Caballa, Venezuela; 1904.4.28.93-96, 4 spec. 37-85mm, San Juan, Cuba; 1904.1.29.97-99, 4 spec. 60-109mm, Pinar de Rio, Cuba, 1905.12.6.72-4, 3 spec. 48-77mm, Vera Cruz; 1905.12.6.67-5, 95mm, Matamoros, Mexico; 1906.6.73.77-9, 3 spec. 109-128mm, Trinidad; 1907.1.18.3-4, 89 & 95mm (labelled syntypes of *N. digueti*, pres. MNI IN), Baja California; 1907.6.28.43-4, 76 & 98mm, Juan Venas, Costa Rica; 1908.5.29.85, 103mm, Jimenez, Colombia, 1909.3.13.76-7, 112 & 213mm, Rio Iroquois, Costa Rica; 1913.6.21.134-153, 10 spec. 67-125mm, Bonacca island, Honduras; 1913.6.21.154-6, 3 spec. 118-127mm, Rio General, Costa Rica; 1913.6.21.157-60, 4 spec. 82-118mm, Mazatlan, Mexico, east coast; 1913.6.21.161-2, 57 & 73mm, Rio Malena, Costa Rica; 1913.6.21.163-4, 59 & 60mm, Ruacan, Costa Rica; 1914.5.18.101, 282mm, Rio Condoto, Colombia; 1920.1.22.151-5, 5 spec. 75-103mm, Tobago; 1931.12.5.39-4, 170mm, Mt Irvine, Tobago, MNI IN: 94: 44-47, 4 spec. 99-172mm, syntypes of *N. digueti*, Baja California, Digue; 94:54-58, 5 spec. 80-88mm, syntypes of *N. digueti*, Baja California, Digue; A.4314, 2 spec. 103 & 130mm, Guadeloupe; A.4317, 2 spec. 95 & 135mm, Martinique. ZIZM: H176, 152mm, lectotype of *A. squamipinne*, Puerto Rico; H.177, 93mm, paralectotype of *A. squamipinne*, Puerto Rico; I.L.178, 8 spec. 60-96mm paralectotypes of *A. squamipinne*, Puerto Rico.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8. A II 10, P 16, L<sub>1</sub> 41-47, tr. 12-13, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 11-12, D<sub>2</sub> sc. 27. Scales with 9-11 primary radii and 2 or 3 secondary radii; mucus canals short, with a small rounded depression at base; body robust, head bluntly rounded scale free to level of posterior nostrils; interorbital increasing with age in relation to head length; eye diameter decreasing relatively to HL with age; eye diameter greater than snout length in small fishes, less in large. Median height of upper lip 1/2 eye diameter or more. Anterior mandibular pores followed by 2 pairs of pits opening to exterior by multiple pores, the rear-most under mid-pupil. Outer rows of teeth usually unicuspid, inner rows with between 2 and 5 cusps, though some fish have unicuspid teeth only. Mouth corner at vertical between posterior nostril and eye, well below lower rim of eye. Preorbital filling space between lip and eye, serrae obsolescent but countable; upper 1/5 of preorbital curving back from snout tip, not reach-

ing a line joining the midpoint of anterior and posterior nostrils; posterior nostril not reaching above upper rim of eye; anterior nostril extending slightly below vertical span of posterior nostril anterior nostril with marked cutaneous rim, higher posteriorly.

Pectoral fins reaching posterior iris when laid forward, reaching vertical from origin of first dorsal fin when laid back in small fish, failing to attain this by increasing margins as growth proceeds; reaching about 1/2 along pelvic fin (past tip of pelvic spine in some specimens). Pelvic fin origin nearer vertical from origin of pectoral fin than to that from origin of first dorsal fin, its tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching ~1/2 along pelvic spine. Sp. 2 of first dorsal fin longer than sp. 1; sp. 4 long, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale short, reaching slightly behind base of sp. 4. Second dorsal fin origin at vertical 1/2 along anal fin base, tips of anterior rays not reaching behind tips of posterior rays; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins moderately scaled anteriorly and along base.

**DISTRIBUTION.** Freshwater of the West Indies and American rivers from Florida to Venezuela and California to the Galapagos islands, possibly spawning at sea (Anderson, 1957).

**REMARKS.** Being geographically isolated there is no risk of confusing *A. monticola* within the genus. *A. monticola* is very variable, several characters varying as size increases, resulting in the large synonymy. With age the lips thicken, the length of the maxilla increases and the posteroventral corner of the preorbital extends posteriorly. The description and figure of *Dajaus elongatus* provided by Kner & Steindachner (1865) identify their species as *A. monticola*. *A. salvini* was described as having a shorter pectoral fin than *A. nasutus* but the collection examined includes intergrades. *A. squamipinne* was described by Mohr (1927) as having a pectoral axillary scale, but the type specimen lacks this feature and is a typical *A. monticola*. *Joturus daguae* was described from the Pacific coast of Columbia by Eigenmann (1917) who reported the upper lip to be terminal, indicating *A. monticola* rather than *Joturus*. Seale (1927) claimed that his *A. hancocki* differed from *A. nasutus* (= *A. monticola*) in having the pelvic fins as long as the pectorals. Pelvic fins in the type of *A. nasutus* are only slightly shorter than the pectoral fins and no other significant differences were listed by Seale.

***Agonostomus telfairii* Bennett, 1831.**

*Agonostomus telfairii* Bennett, 1831: 166, Mauritius; Peters, 1853: 18, pl. 2, fig. 2, Mozambique; Bleeker, 1879a: 18, Mauritius; Boulenger, 1916: 99, fig. 60, Johannes, Comoro Islands, Mauritius; Anjouan, Réunion; Fontaine, 1928: 386, fig. 1, Réunion; Pellegrin, 1933: 182, fig. 99(ii), 100, Madagascar.

*Agonostoma telfairii* Günther, 1861b: 463, Anjouan, Mauritius; Bleeker, 1874: 79, Madagascar; Sauvage, 1891: 403, Madagascar.

*Nestis dobuloideus* Valenciennes, 1836: 171(127), Mauritius, Réunion.

*Agonostoma dobuloideus* Günther, 1861b: 462, Mauritius; Bleeker, 1874: 79, Madagascar; 1879a: 18, Mauritius; Sauvage, 1891: 398, pl. 42, fig. 5, Madagascar.

*Agonostomus dobuloideus* Pellegrin, 1933: 184, fig. 99(i), Madagascar.

*Nestis cyprinoides* Valenciennes, 1836: 167(124), pl. 137, Réunion, Mauritius.

**HOLOTYPE.** BMNH 1861.8.14.9, Mauritius; purchased from Gerard. Günther (1861b) indicated that this specimen was the type, although it came to the British Museum, not from Bennett, but through a dealer, some 30 years after the original description. Many of Bennett's specimens came to the museum via the Zoological Society in 1852-53 and possibly Günther had evidence that this was Bennett's specimen. Otherwise Günther could be considered to have established a neotype.

**MATERIAL EXAMINED.** 11 specimens, 65-210mm SL (including the types of *A. telfairii*, *N. dobuloideus* and *N. cyprinoides*) from Mauritius, Réunion and Anjouan. BMNH: 1861.8.14.9, 107mm, holotype of *A. telfairii*, Mauritius, pchsd Gerrard, 1861.5.2.81-3, 3 spec. 52-64mm, San Juan. MNHN: 62.198, 199mm, Madagascar; 5553, 210mm, syntype of *N. cyprinoides*, Mauritius, Desjardins; A960, 198mm, Réunion; A953, 2 spec. 65 & 150mm, syntypes of *N. cyprinoides*, Mauritius, Dussumier; A1319, 2 spec. 62 & 65mm, syntypes of *N. cyprinoides*, Réunion, Leschenault; 4650, 360mm, holotype of *N. dobuloideus*, Mauritius, Lamarre Piquot.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> 18, A 11 10, P 16 (17), L1 41-42; tr. 12, ped. 11, pect. sc. 11, Disc. 10, D<sub>2</sub> sc. 23. Scales with short mucus canals. Body moderately robust, head bluntly pointed, scale-free to anterior rim of eye, its upper profile sloping evenly; eye diameter greater than snout in small fishes, less in large; snout length less than eye diameter; upper lip median height half eye diameter or more; median upper edge of lip, expanding to fill marked concavity in snout. Anterior mandibular pores large, just behind outer edge of lip; a second pair close behind but further from midline and near end of lip groove. Teeth sessile, outer 1-3 rows usually unicuspid, inner rows bicuspid or sometimes tricuspid (one specimen had all rows unicuspid); teeth incisor-like, slightly curved, pointed. Mouth corner on vertical from posterior nostril in young fishes, moving back to vertical from anterior rim of eye in large fishes. Tip of upper jaw slightly below level of mouth corner, on vertical from anterior rim of eye in young fishes, moving back to verti-

cal from edge curving convexly, reaching level about 3/4 up upper lip and on line joining mid-points of posterior and anterior nostrils; lower edge reaching below lower rim of eye. Posterior nostril not reaching above upper rim of eye, anterior nostril slightly below span of posterior; moderate cutaneous rim around anterior.

Pectoral fin reaching to between mid-eye and anterior iris when laid forward, just to vertical from first dorsal fin origin and c. 3/4 along pelvic fin when laid back. Pelvic fin origin equidistant from verticals from origin of first dorsal and pectoral fins, its tip reaching well back to vertical from midway along membrane behind sp. 4; axillary scale reaching <1/2 along pelvic spine. Sp. 1 of first dorsal longer than sp. 2; sp. 4 short, not reaching beyond vertical from tip of sp. 3 when fin raised; axillary scale short, reaching base of sp. 4 or slightly beyond. Second dorsal fin origin on vertical quarter along anal fin base; fin slightly scaled anteriorly and along base; tips of anterior rays reaching beyond tips of posterior rays. Anal fin slightly higher than second dorsal, both distinctly higher than first dorsal; anal fin scaled lightly anteriorly and along base.

**DISTRIBUTION.** Madagascar, Réunion, Mauritius and Anjouan.

**REMARKS.** Valenciennes (1836: 171) listed several differences between his *Nestis dobuloideus* and his *N. cyprinoides* (based however on a single specimen of the former). In particular he stated that the teeth of *N. dobuloideus* were scarcely visible in the upper lip. Pellegrin (1933) reported 3-4 upper rows of teeth in *dobuloideus* against 8 in *telfairii*. The holotype of *A. telfairii* has 6 upper rows but specimens of similar size had 3-8 rows. Valenciennes also recorded 14 pectoral rays against 17 in his *N. cyprinoides*. But the types of both species have 16 pectoral rays, as have all the specimens inspected.

***Joturus* Poey, 1860**

*Joturus* Poey, 1860: 263, pl. 18, figs 4-5. Type species *Joturus pichardi* Poey, 1860.

*Neonhynchichthys* Regan, 1908: 461. Type species *Joturus atpes* Jordan & Gilbert, 1883b.

**DISTRIBUTION.** Mexico to Panama on Atlantic and Pacific coasts, Caribbean, Florida.

**DIAGNOSIS.** Mouth inferior, gape oblique; mid-gape at level of lower iris; mouth corner well below level of lower eye rim; mouth corner vertically under posterior nostril; upper jaw end on line of gape, under anterior half of eye; upper lip thick, recessed under snout (lip terminal in juve-



niles), height at mid-gape  $<1/2$  eye diameter; lower lip thick, not turned down at edge, entire; lips without external papillae or crenulations; lip groove up to  $3/4$  lower lip length; no symphyseal knob; no fleshy lobes externally between lower jaw rami; mandibular pores obscure. Maxilla massive, straight, not curving down behind mouth corner, its tendon flange  $1/4$  down shaft, well above mouth corner; maxilla not visible above premaxilla, nor behind and below mouth corner when mouth closed; coronoid process of dentary massive, rising well in front of mouth corner; mandibular angle acute. Without labial teeth; sessile teeth in several rows, inner rows usually multicuspid; wide gap between teeth at symphysis; teeth on vomer, palatines, pterygoids and tongue; tongue flat or slightly domed, without median ridge; no adipose tissue on face, pre-orbital massive, flat, without folds or ridges, not notched, filling space between lip and eye. Nostrils very close together, posterior nearer eye than anterior to lip, not reaching above level of upper eye rim; eye relatively small, more than its own diameter below dorsal contour of head in mature specimens; interorbital high and convex; opercular opening short, not nearly reaching under eye; gill rakers type 4.

Upper insertion of pectoral fin at level of upper  $1/3$  of pupil, without axillary scale. First dorsal fin origin nearer snout tip than to caudal base; second dorsal fin origin variable; 2 anal spines in adults; scales ctenoid, mucus canals elongate, none multicanaliculate. No opercular spine. Caudal fin deeply forked. Stomach without gizzard; 2 pyloric caeca; intestine in 3 loops, its length not more than twice SL.

REMARKS. This genus differs from other Agonostominae in the fleshy protruding snout, the unusually short ventral opening to the operculum and in the gill rakers. Regan (1908) erected *Xenorhynchichthys* for specimens lacking palatine teeth. Examination of a series of specimens shows that those smaller than 150mm SL lacked palatine teeth. No other distinction was suggested by Regan.

#### *Joturus pichardi* Poey, 1860

*Joturus pichardi* Poey, 1860: 263, Cuba, in freshwater; Jordan, 1887a: 35, Havana; Jordan & Evermann, 1896: 821, Cuba, Panama, central Mexico, Vera Cruz; 1902: 257, fig., Florida, Cuba; Fowler, 1903: 748, San Domingo; Regan 1907a: 70, Cuba.

*Agonostoma globiceps* Günther, 1874: 370, Vera Cruz.

*Joturus stipes* Jordan & Gilbert, 1883b: 373, Panama.

*Xenorhynchichthys stipes* Regan, 1908: 461, Costa Rica.

TABLE 3. Biometrics of *Joturus* and *Cestraeus* spp. Abbreviations as in table 2 plus na = not applicable; Sp.1 = length of first anal fin spine; Sp.2 = length of second anal fin spine; Sp.3 = length of third anal fin spine; \* secondary radii.

Species	<i>J. pichardi</i>	<i>C. plicatilis</i>	<i>C. oxyrhynchus</i>
Scale radii	7-9	8 + 6*	9-10
Depth (%SL)	28.0-32.4	23.0-25.5	20.8-24.8
HL (%SL)	22.8-26.0	21.8-24.2	23.0-24.0
HW (%HL)	74.5-75.5	71.3-72.2	61.5-69.0
IO (%HL)	40.0-51.0	49.4-50.0	36.0-48.0
ED (%HL)	25.0-30.0	18.0-20.0	22.0-36.5
SnL (%HL)	30.0-34.4	28.5-29.3	26.9-31.2
ULH (%HL)	12.0-15.0	10.2-12.3	8.0-9.0
MW/ML	2.1-2.8	0.55-0.75	0.5-0.55
PL (%HL)	80.0-90.0	80.0-100.0	85.0-90.0
PB (%PL)	26.0-29.0	31.4-32.5	29.0-35.0
VL (%PL)	85.2-91.7	80.0-93.0	89.0-95.3
VAX (%VL)	46.0-52.8	26.0-26.5	32.0-33.0
Ped (%D)	40.0-44.0	48.0-52.3	48.5-53.8
TR(UL)	6-8	2-3	2-4
TR(LL)	0	2-3	1-3
LES	8-16	8-10	8-18
FES	0	0	6-16
Sp.2/Sp.1	1.2	2.0-2.3	2.7-2.75
Sp.3/Sp.2	na	1.6-17	1.5
GR	18.8-28/27-40	30-34/52-56	24-32/38-54

TYPE. None. Type locality, Cuba.

MATERIAL EXAMINED. 15 specimens, 77-230mm SL (including the types of *A. globiceps* and *J. stipes*) from Mexico, Panama and Costa Rica. BMNH: 1873.6.5.1, 210mm, holotype of *A. globiceps*, Mazatlan, Mexico, Schmeltz; 1909.3.13.78-81, 4 spec. 132-154mm, R. Iroquois, Costa Rica; 1925.3.6.199-204, 6 spec. 77-125, Koi Ck, Rio Pelire, Costa Rica; 1925.3.6.205-208, 4 spec. 200-230mm, Chiriqui Lake.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 9, A II 11, P 18, L 143-45, tr. 12, ped. 9, pect sc. 11-13, D<sub>1</sub> 10-11, D<sub>2</sub> sc. 26-27. Scales with 7-9 primary and up to 8 secondary radii. Body deep but narrow; head bluntly pointed, scale-free to posterior nostril, upper profile almost horizontal; interorbital less than eye diameter in small fishes, more than twice in large fishes; eye diameter equal to snout length in small fishes, smaller in large. Median height of upper lip  $<1/2$  eye diameter; mandibular angle obtuse. Outer row of teeth in upper jaw incisor-like, unicuspid, inner rows and all teeth on lower jaw multicuspid. Mouth corner  $>1/2$  eye diameter below eye; front edge of preorbital smooth and straight, upper end below line joining

midpoints of posterior and anterior nostrils; with growth front edge of preorbital grows posteriorly from below the posterior nostril to below the anterior half of the eye to lie beneath the original lower edge. Anterior nostril with high cutaneous rim and wholly within vertical span of posterior nostril.

Pectoral fin reaching anterior rim of eye when laid forward, to vertical from sp. 1 of first dorsal fin and  $>1/2$  along pelvic fin (not quite to tip of pelvic spine) when laid back. Pelvic fin origin distinctly nearer vertical from first dorsal fin origin than to that from the pectoral fin origin, its tip reaching vertical slightly behind sp. 4, axillary scale reaching  $3/4$  along pelvic spine. Dorsal fin sp. 1 longer than sp. 2, sp. 4 long reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching  $1/2$  along membrane behind sp. 4. Second dorsal fin origin variable, from opposite anal origin to a  $1/5$  along anal base; anal and second dorsal fins scaled and falcate, tips of anterior rays reach to tips of posterior rays; anal fin higher than second dorsal, both distinctly higher than first dorsal. Tail and median fins with black bars.

**DISTRIBUTION.** Mexico to Panama (both coasts), Caribbean, Florida, in freshwater.

**REMARKS.** Young *Joturus* in which the snout has not developed are very like young *Agonostomus*. *J. stipes* was based on small specimens without palatine teeth, but later authorities, including Meek & Hildebrand (1916) included it in *J. pichardi*. *J. globiceps* of Günther (1874) was a large specimen with a well developed snout. Specimens in the British Museum include intergrades between the two types.

### *Cestraeus* Valenciennes, 1836

*Cestraeus* Valenciennes, 1836: 157(115), pl. 315. Type species *Cestraeus plicatilis* Valenciennes, 1836, by subsequent designation of Jordan, 1919: 185; Weber & de Beaufort, 1922: 261.

*Agonostomus* (part) Günther, 1861b.

*Gonistomus* MacDonald, 1869: 39. Type species *Gonistomus lina-lua* MacDonald, 1869.

*Aeschrichthys* Macleay, 1884a: 5. Type species *Aeschrichthys goldiei* Macleay, 1884a.

**DISTRIBUTION.** Western Pacific.

**DIAGNOSIS.** Mouth gape oblique, mid-gape at level of lower rim of eye; interorbital convex; mouth corner almost eye diameter below eye, reaching vertical from anterior rim of eye; upper jaw end above line of gape, reaching vertical between anterior rim of eye and mid-pupil; upper lip thick, terminal, its height at mid-gape  $<1/2$  eye diameter; lower lip thick-edged, not turned

down, entire; lips without external papillae or crenulations; lip groove  $1/5-1/2$  length of lower lip; symphyseal knob low, well in from lip edge; fleshy lobes over end of upper jaws and 1 or 2 pairs of fleshy lobes lying between the lower jaw rami. Maxilla almost straight, curving slightly posteriorly, not curving down behind mouth corner; visible above premaxilla but not visible below and behind mouth corner when mouth closed; coronoid process of dentary massive, rising well in front of mouth corner; mandibular angle acute. Without labial teeth; sessile teeth in several rows, outer teeth unicuspid, inner teeth variably unicuspid, bicuspid or tricuspid; teeth on vomer, palatines and pterygoids, variably on tongue, tongue flat, tip not free; no adipose tissue on face; preorbital massive, flat, without folds or ridges, not notched, filling only  $3/4$  space between lip and eye; nostrils very close together, posterior nearer eye than anterior to lip; posterior nostril reaching above level of upper rim of eye; anterior nostril wholly within vertical span of posterior; opercular opening reaching under eye; gill-rakers type 3 or 4. Upper insertion of pectoral fin at level at or above level of upper rim of eye; axillary scale rudimentary; first dorsal fin origin nearer tip of snout than to caudal base; second dorsal fin origin between verticals  $1/3-1/2$  along anal fin base; 3 anal spines in adults, 2 in young. Scales ctenoid, mucus grooves long, reaching posterior edge of scales; no multicanalliculate scales. No opercular spine; caudal fin deeply forked. Without gizzard; 2 pyloric caeca.

**REMARKS.** This genus differs from other Mugilidae in the free-ending lobes over the end of the jaws and similar lobes lying between the lower jaw rami. It is also unusual in having the length of the mouth gape greater than the mouth width and in the extent to which the mouth reaches back under the eye.

The genus was described by Valenciennes with 2 species, but Günther (1861b) included these in *Agonostomus*. Weber & de Beaufort (1922) revived *Cestraeus*. MacDonald (1869) and Macleay (1883) produced new generic names for what they believed to be new species. However, they are considered conspecific with *Cestraeus plicatilis* (see below). Roxas (1934) and Schultz (1946) considered *Cestraeus* closely related to *Chaenomugil*, largely on the nature of the jaws. But in *Chaenomugil* the teeth are labial, the stomach has a gizzard and the intestine is very long, features which place this genus in the Mugilinae.

### KEY TO THE SPECIES OF *CESTRAEUS*.

1. Free-ending lobes on chin reaching posterior end of lower jaw; scales on caudal peduncle 9 (Indo-Australian Archipelago to Fiji and Philippines)  
 . . . . . *plicatilis* Valenciennes

Free-ending lobes on chin not reaching end of lower jaw; scales on peduncle 11 (New Guinea to New Caledonia, Fiji and the Philippines)  
 . . . . . *oxyrhynchus* Valenciennes

### ***Cestraeus plicatilis* Valenciennes, 1836**

*Cestraeus plicatilis* Valenciennes, 1836: 157(116), pl. 315, Celebes, freshwater; Bleeker, 1851b: 213, Celebes; Weber & De Beaufort, 1915: 27, fig. 3, New Caledonia, in rivers; 1922: 261, Menados, Celebes, New Caledonia, New Hebrides; Fowler, 1932b: 8 Marquesas.  
*Agonostoma plicatile* Günther, 1861b: 461, Celebes, Aneitum; 1877: 219, Aneitum, New Caledonia.  
*Gonostomus loa-loa* MacDonald, 1869: 38, pl. 1, Wai Venu; Viti Laeve, Fiji.  
*Agonostomus loa-loa* Jordan & Seale, 1906: 218, Samoa.  
*Aeschrichthys goldiei* (partim) Macleay, 1884a: 5, fig., Goldie River, New Guinea.  
*Cestraeus goldiei* Weber & De Beaufort 1912: 135, Timor; 1915: 26, fig. 2, New Caledonia; 1922: 262, figs 68-69, Nail Bidjali River, Timor 35km upstream; Goldie River, New Guinea; Thomson, 1954: 120, fig. 15, Goldie River, New Guinea; Munro, 1967: 166, pl. 18, fig., New Guinea. Holotype: MNHN: A2984, Celebes, Quoy & Gaimard. Examined.

**MATERIAL EXAMINED.** Holotype and 15 specimens, 91-390mm SL from the Celebes, New Guinea, New Caledonia and Fiji. BMNH: 1861.5.22.21, 244mm, Aneitum, New Hebrides; 1879.6.25.1, 110mm, Viti-Levu, Fiji; 1903.3.10.26, 288mm, Dinawa, Owen Stanley Range at 4,000ft altitude; 1913.11.13.1, 276mm, New Guinea; 1928.1.17.23, 390mm, Jordan R., New Hebrides. MNHN: A.2894, 235mm, holotype of *C. plicatilis*, Celebes, Quoy & Gaimard; 1080.91 & 128mm New Caledonia. AM: I.133395, 380mm, lectotype by present designation of *A. goldiei*, Goldie R., New Guinea, Goldie; I.9050, 284mm; I.1051, 240mm; I.9053, 207mm; I.9060, 233mm; I.9745, 273mm; I.9747, 230mm, all from the Goldie R.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 20, L I 39-44, tr. 12, ped. 9, pect. sc. 12, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 24. Scales with 8 primary radii and up to 6 secondary radii; mucus canals long, sometimes sinuous. Body stout, head bluntly rounded; interorbital <1.5 times eye diameter, markedly convex in older specimens; eye diameter less than snout length. Upper lip projecting beyond snout by distance equal to 1/2 eye diameter; horny ridge from outer edge mid-lip to inner edge 1/3 from mid-lip to lip end; lower lip edge horny, lamellate; lip groove 1/3-1/2 lip length; 4 pairs small mandibular pores, none near symphysis; rami of lower jaws straight in posterior half, acutely pointed anteriorly. Fleshy lobes covering ends of both jaws; similar lobes externally between lower jaw rami, posterior third lying freely; small pocket between median and jaw lobes, roofed by fleshy pad. Teeth unicuspid, spatulate in upper lip, incisor-like in lower, gradually lost with age; teeth on vo-

mer, pterygoids, and palatines, but not on flat tongue. Preorbital massive, filling only 3/4 space lip to eye; front edge not serrate, upper end c.2/3 up upper lip, on line joining midpoints of anterior and posterior nostrils. Broad cutaneous flap around anterior nostril.

Pectoral fin reaching to posterior nostril when laid forward, reaching vertical from first dorsal fin origin in large fish, not quite in small, and >1/2 along pelvic fin (a little past tip of pelvic spine) when laid back; ventrally a tassel, apparently representing 5 splayed rays. Pelvic fin origin equidistant from verticals from origin of first dorsal fin and pectoral fin, its tip reaching vertical well behind base of sp. 4 of first dorsal fin; axillary scale reaching <1/2 along pelvic spine. Sp. 1 of first dorsal fin longer than sp. 2; sp. 4 unusually long, projecting well behind tip of sp. 3 when fin raised; tip of axillary scale reaching 1/3 along membrane behind sp. 4. Second dorsal fin origin on vertical 1/3 along anal fin base, tips of anterior rays reaching behind tips of posterior rays. Anal fin twice as high as first dorsal fin; second dorsal fin higher than first; second dorsal and anal fins scaled anteriorly and along base.

**DISTRIBUTION.** Indo-Australian Archipelago, New Caledonia, Fiji, Philippines.

**REMARKS.** Valenciennes (1836) stated that the vomer of *C. plicatilis* did not bear teeth, but the holotype has 2 patches on the vomer, as have the other specimens. *A. goldiei* cannot therefore be differentiated on this point as Weber & De Beaufort (1922) considered. Macleay (1864a) also described the pectoral fin as comparatively long, but the relative length varies with size, being < head length in fish smaller than 300mm SL, but equal to HL in larger fishes. Weber & De Beaufort suggested that the snout is pointed in *A. goldiei*, but blunt in *C. plicatilis*, a characteristic which also changes with size. They also recorded the fin ray counts as being different, but the types of the nominal species have the same number of pectoral fin rays. Among the 11 syntypes of *Aeschrichthys goldiei* there are 8 identical with the Paris type of *Cestraeus plicatilis*, but 3 are specimens of *C. oxyrhynchus*. I record the specimen AM I13395 as lectotype, a specimen 380mm SL to which Macleay attached a card labelled 'Type, 1 spec. 15'.

Fowler (1928a) stated that the figure of *G. loa-loa* 'appears to have been intended for this species'. There is nothing in the figure or description to distinguish *G. loa-loa* from *C. plicatilis*. The characters mentioned in the key and the shape of

the preorbital serve to distinguish *C. plicatilis* from *C. oxyrhynchus*.

***Cestraeus oxyrhynchus* Valenciennes, 1836**

*Cestraeus oxyrhynchus* Valenciennes, 1836: 162(120), Celebes; Weber & De Beaufort, 1922: 263, Denkulen, Padang, Sunhawa, Celebes, Sawangan, Menado, Klabat atas, Buton, Ambon, Ceram, Batjan; Roxas, 1934: 423, Luzon.

*Cestraeus oxyrhynchus* Bleeker, 1855b: 307, Celebes; 1860c: 33, Sumatra; 1861a: 66, Banka.

*Agonostoma oxyrhynchum* Günther, 1861b: 461, Celebes, Batjan, Sumatra.

*Agonostoma oxyrhynchus* Bleeker, 1862: 110, Batja. Holotype: Celebes, Quoy & Gaimard, MNHN A.4313. Examined.

**MATERIAL EXAMINED.** Holotype and 5 specimens. BMNH: 1879.3.4.1, 107mm, New Caledonia; 1879.6.5.2, 230mm, Viti Levu, Fiji. MNHN: A.4313, 223mm, holotype of *C. oxyrhynchus*, Celebes, coll. Quoy & Gaimard, AM. 19052, 223mm, Goldie R. New Guinea; 19054, 151mm, Goldie R.; 19061, 205mm, Goldie R.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 20-21, L1 40-45, tr. 12, ped 11, pect. sc. 11-12, D<sub>1</sub> sc. 12-14, D<sub>2</sub> sc. 25-27. Mucus canals scarce on dorsal scales; deeper and wider on flank. Body slender; head bluntly rounded, scale-free only in front of anterior nostril, its width relative to length increasing with size; interorbital flat in small fishes, becoming high and convex with growth, slightly large than eye diameter in large fish; eye diameter greater than snout length in small fishes, less in large. Upper lip projecting distance equal to 1/4 eye diameter, its height increasing in median fifth; lip groove 1/5 length of lower lip; four pairs mandibular pores of equal size; rami of lower jaw almost straight in posterior third, curving in long arc anteriorly; fleshy lobe covering ends of both jaws, smaller than in *C. plicatilis*; paired lobes between rami of lower jaw, reaching at most 80% of jaw length; no pocket between jaw lobe and median lobe. Teeth slender, in upper lip multicuspid; in lower lip unicuspid, sometimes lost in large fish; bicuspid teeth on vomer, unicuspid on pterygoids, palatines and tongue. Membrane of mouth roof with long pointed papillae. Serrae on lower edge of preorbital obsolescent; preorbital curving convexly along upper half of front edge, upper end half up upper lip, on line joining midpoints of posterior and anterior nostrils.

Pectoral fin reaching anterior 1/2 of eye when laid forward, not quite reaching to vertical from origin of first dorsal fin and c. 1/2 along pelvic fin (not reaching tip of pelvic spine) when laid back; axillary scale small and bluntly rounded; 5-6 lower rays splayed into tassel. Pelvic fin origin

nearer vertical from origin of pectoral fin than to vertical from origin of first dorsal fin, its tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching c. 2/3 along pelvic spine. Sp. 1 and sp. 2 of first dorsal fin subequal; sp. 4 long, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/4 along membrane behind sp. 4. Second dorsal fin origin on vertical 1/2 along anal fin base, tips of anterior rays not reaching behind tips of posterior rays. Anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins lightly scaled anteriorly.

**REMARKS.** The length of the lobes between the jaw rami and the number of rows of scales down the side of the peduncle separate this species from *C. plicatilis*.

**DISTRIBUTION.** Indo-Australian Archipelago, New Caledonia, Fiji, Philippines.

***Aldrichetta* Whitley, 1945**

*Aldrichetta* Whitley, 1945: 19. Type species *Mugil forsteri* Valenciennes, 1836.

**DIAGNOSIS.** Mouth gape oblique, mid-gape at level of lower rim of eye, reaching vertical from posterior nostril; upper jaw end on line of gape reaching vertical between posterior nostril and anterior rim of eye. Upper lip terminal, thick and high, without papillae or crenulations; lower lip thick, not permanently turned down at edge, entire, posterior end curving up, symphyseal knob low, behind edge of lower lip; no fleshy lobes over ends of jaws or between jaw rami. Maxilla short, fixed at upper end; upper 1/4 almost straight, curving down in lower 3/4; tendon flange about 1/3 down shaft; maxilla not visible behind or below mouth corner when mouth closed; coronoid process of dentary massive, rising well before mouth corner; mandibular angle acute. Sessile teeth in both lips, but also labial teeth on edge of lower lip; teeth on vomer, pterygoids, palatines and tongue. No adipose tissue on face; preorbital massive, filling space lip to eye; posterior half submerged in facial tissue, not notched, but with distinct transverse ridge. Nostrils nearer each other than to lip or eye; posterior not reaching above level of upper rim of eye; interorbital convex. Opercular opening reaching under eye. Gill rakers type 3.

Upper insertion of pectoral fin at level of upper rim of eye, without axillary scale. First dorsal fin origin nearer caudal base than to snout tip; second dorsal fin origin opposite mid-base of anal fin; 3 anal spines in adult, caudal fin deeply forked;



scales cycloid on flanks, ctenoid ventrally and sometimes on caudal peduncle. No spine on operculum. Stomach with thicker walls than in other Agonostominae; gizzard feeble; pyloric caeca 2; intestine in 3 loops, its length than twice SL.

REMARKS. This monospecific genus has been included either in *Agonostomus* or *Dajaus*. It is transitional between Agonostominae and Mugilinae in many features such as weak development of a gizzard and presence of labial teeth, but the sessile teeth and massive coronoid process link it to the Agonostominae.

### *Aldrichetta forsteri* (Valenciennes, 1836)

*Mugil albula* Bloch & Schneider, 1801: 120, New Zealand; Forster, 1844: 145, New Zealand, non Linnaeus.

*Mugil forsteri* Valenciennes, 1836: 141(104), New Zealand.

*Dajaus forsteri* Richardson, 1848: 77, pl. 44, figs 20-26, New Zealand.

*Agonostoma forsteri* Günther, 1861b: 465, Hobson's Bay, Port Arthur; Steindachner, 1866: 460, Port Jackson, Hobson's Bay, New Zealand; 1878: 383, South Australia; Klunzinger, 1872: 35, Port Phillip; 1880: 396, Port Phillip, Hobson's Bay; King George Sound; Hutton, 1872: 37, New Zealand; Hector, 1872: 114, pl. 6, fig. 58, New Zealand.

*Agonostomus forsteri* Ogilby, 1897a: 79, Tasmania; Stead, 1906: 79, Newcastle; 1908: 466, NSW; Waite, 1923: 108, South Australia; Lord & Scott, 1924: 47, Tasmania; Graham, 1953: 214, fig., New Zealand.

*Aldrichetta forsteri* Whitley, 1945: 19, fig. 10, Bunbury; Graham, 1953: 214, fig., New Zealand; Thomson, 1954: 115, pl. 2, fig. 3, Garden Is., Point Cloates, Leschenault Inlet, King George Sound, Bremer Bay, Ceduna, Port Adelaide, Port Phillip, Lakes Entrance, Pittwater, Moruya, Merimbula R., Spring Bay, Norfolk Bay, Waikato; Scott, 1962: 134, fig., South Australia; Cadwallader & Backhouse, 1983: 127, Victoria; Gomon et al. 1994: 660, S Australia.

*Dajaus diemensis* Richardson, 1840: 25, King George Sound, Port Arthur; 1842: 123, Port Arthur; 1848: 37, pl. 26, figs 1-4, Port Arthur, King George Sound; Jenyns, 1842: 82, King George Sound; Bleeker, 1855d: 11, Australia.

*Agonostoma diemensis* Castelnau, 1872: 141, Victoria; 1873b: 136, WA; Macleay, 1880: 48, WA, Port Phillip.

(?)*Myxus analis* Kner, 1865: 230 pl. 10, fig. 1, Sydney.

*Agonostoma lacustris* Castelnau, 1872: 142, Gippsland Lakes; Macleay, 1880: 425, Gippsland Lakes.

*Agonostoma tasmanica* Castelnau, 1872: 142 (nom. nov. for *A. diemensis*).

Type: apparently lost: records of the MNHN do not include any reference to the type. Paratype of *Mugil peronii* Valenciennes, 1836 (A.4965) is a specimen of *A. forsteri* though the holotype (MNHN A.3620) is a specimen of *Liza argentea*. Blanc & Hureau (1972) do not list a type. Type Locality: New Zealand.

MATERIAL EXAMINED. 70 specimens, 65-264mm SL from Australia and New Zealand. BMNH: 1844.2.12.10, 193mm, Port Arthur; 1843.18.31.35, 5 spec. 66-75mm, NZ; 1848.3.19.4-6, 3 spec. 78-105mm, NZ; 1855.8.16.91, 124mm, Kermadec Is; 1855.9.19.4, 60mm, locality unknown; 1855.9.19.223, 138mm, locality unknown; 1855.9.19.230-1, 104 & 126mm, locality unknown; 1863.1.15.9, 159mm, South Australia; 1863.4.13.1,

169mm, NZ; 1869.10.13.5, 257mm, Tasmania; 1871.9.18.5, 2 spec. 235 & 256mm, Hobart; 1873.12.13.35, 227mm, Wellington; 1873.12.13.36, 15 spec. 81-154mm, Dunedin; 1877.4.17.24, 117mm, Hobson's Bay; 1886.11.18.51, 223mm, (Dunedin); 1896.6.17.56, 298mm, Victoria; 1896.6.17.57-59, 3 spec. 109-114mm, Melbourne market; 1899.2.14.38-42, 6 spec. 150-206mm, Port Albert; 1935.3.14.144, 150mm, Monawatu R.; 1964.4.30.72, 110mm, Horokiwi R. MNHN: 4965, 201mm, paratype of *M. peronii*, Westernport Bay, Quoy & Gaimard, 1424, 164mm, Melbourne. AM: I.10, 100mm, Coorong; I.6281-4, 4 spec. 162-184mm, Tamar R.; I.13231, 133mm, Fremantle; I.14185, 124mm, Coorong; I. 14751, 107mm, Porto Bello; IA. 657, 76mm, King George Sound; IA.7212, 217mm, Swan R.; IB.79, 98mm, Tasmania; IB.1845, 258mm, Pt Cook. WAM: P.341, 223mm, Garden Is.; P.354, 264mm, Bremer Bay P.1410, 206mm, Swan R.; P.2690-2, 3 spec. 169-182mm, Leschenault Inlet.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 9, A III 12, P 16, LI 58-62, tr. 18-19; ped. 11, pect. sc. 18-20; D<sub>1</sub> sc. 19-22; D<sub>2</sub> sc. 37-40. Scales with short mucus canals, often transverse, a few double canals on lateral and dorsal scales. Body slender, head pointed, scale-free to posterior nostril; interorbital narrow, slightly convex; eye diameter less than snout length. Upper lip thickness = 1/3 eye diameter, its median height c. 1/4 eye diameter; anterior mandibular pores large, at base of symphysis, another simple pair behind, followed by 3 pairs covered by membranes perforated by multiple holes. Multiple rows of sessile teeth in both jaws, and a labial row in lower lip; teeth unicuspid, long, pointed, slightly recurving in upper lip; labial teeth similar but smaller; teeth lost with age; tongue generally flat, but with a slight median ridge; teeth in broad band along tongue edge. Mouth corner on vertical from posterior nostril; tip of upper jaw below level of lower rim of eye, reaching vertical between posterior nostril and anterior rim of eye; maxilla tendon flange c. 1/3 down shaft, at about mid-eye level, well above mouth corner; shaft of maxilla gently curving, not bending markedly in its lower 1/4 and not visible behind or below mouth corner, when mouth closed; anterior face of maxilla grooved. Upper end of preorbital c. 3/4 up upper lip, on line joining midpoints of posterior and anterior nostrils; anterior nostrils entirely within vertical span of posterior nostrils; anterior nostril surrounded by wide cutaneous rim, higher on posterior margin.

Pectoral fin reaching anterior rim of pupil when laid forward, not nearly to the origin of the first dorsal fin and c. 2/3 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral origin than to that from first dorsal fin origin, its tip barely reaching vertical from first dorsal fin origin; axillary scale reaching 2/3 length of pelvic spine. Sp. 2 of first

dorsal fin longer than sp. 1; sp. 4 weak, not nearly reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching just behind base of sp. 4. Tips of anterior rays of second dorsal fin reaching well behind tips of posterior rays. Anal fin distinctly higher than second dorsal fin and both higher than first dorsal; scaled lightly anteriorly.

DISTRIBUTION. S Australia and New Zealand

REMARKS. The number of longitudinal scales, number of soft dorsal rays and number of anal rays are greater than in any other mugilid. *A. forsteri* has the general body form of *Myxus* but retains agonostomine features such as sessile teeth and thick lips. The only apparent distinction between the New Zealand and Australian fish is the gill-raker count (19-24/24-29 in Australian fish; 20-26/35-48 in those from New Zealand).

If this is regarded as sufficient to warrant sub-specific status, the NZ fish may be regarded as *A. forsteri forsteri* and the Australian as *A. forsteri diemensis*. Günther (1861b) recorded 4 specimens from the Haslar collection and affirmed that they were probably the 'typical specimens' of *Dajaus diemensis*. These 4 specimens are still in the collection and do not differ from typical *A. forsteri*. Richardson described a specimen, which he regarded as being *Dajaus forsteri*, as having 11 anal rays and asserted that it was differentiated from his *D. diemensis* by lacking the 'posterior scabrous plate' on the palate and a different tooth pattern on the tongue. His specimen of *D. forsteri* was only 4.5 inches long, while his specimens assigned to *diemensis* were 10-14 inches. Palatal teeth are not developed in the small stages of many mugilid species and the pattern of the tongue is individually variable in many species. *Myxus analis* of Kner (1865) from Sydney was inadequately described but is possibly this species.

#### Family MUGILIDAE Subfamily MUGILINAE

1, teeth, if present, labial, connected to dentary or premaxillary by long fibres; 2, superior pharyngeals without teeth; 3, gill rakers long and fine; 4, preorbital with a transverse ridge; 5, adults with 3 anal spines, 2 in early juveniles; 6, interorbital almost flat, head broad; 7, stomach differentiated into a thin-walled crop and a thick-walled gizzard; 8, intestine elaborately coiled, 3.5-9 times SL; 9, symphyseal knob high and rising abruptly from lip (except *Chaenomugil*).

#### KEY TO THE GENERA OF MUGILINAE

1. Snout overhanging upper lip; eyes above dorsal contour of head. . . . . *Rhinomugil* Gill
- Upper lip not overhung by snout; eyes lateral . . . . . 2
- 2(1). Spine on operculum projecting over pectoral fin base . . . . . *Sicamugil* Fowler
- No opercular spine . . . . .
- 3(2). Teeth with long glistening white stems and divided lips; end of jaw above level of mouth corner . . . . . *Chaenomugil* Gill
- Teeth slight, of neutral colour; end of jaw at or below level of mouth corner. . . . . 4
- 4(3). Lower third of upper lip ornamented by enlarged papillae or crenulations . . . . . 7
- Lower third of upper lip not ornamented . . . . . 9
- 7(4). Preorbital deeply notched; upper margin of notch almost horizontal; single row of horny-tipped projections on upper lip . . . . . *Oculaluteres* Fowler
- Preorbital either not notched or upper margin of notch oblique; lips with one or more rows of papillae . . . . . 8
- 8(7). Scales with flexible membranous margins posteriorly; a long pectoral axillary scale . . . . . *Crenomugil* Schultz
- Scales with firm edges; pectoral axillary scale absent or rudimentary. . . . . *Chelon* Arzuffi
- 9(4). Jaw end on line of gape; adipose tissue in adult reaches pupil . . . . . *Mugil* Linnaeus
- Jaw end below line of gape; either no adipose tissue or at most extending on to iris . . . . . 10
- 10(9). Jaw end slightly below line of gape; teeth on vomer and palatines . . . . . *Myxus* Günther
- Jaw end well below line of gape; no teeth on vomer or palatine . . . . .
- 11(10). Scales with flexible membranous edge; pectoral axillary scale long, lip groove short . . . . . *Valanmugil* Smith
- Scales without flexible membranous posterior edge; pectoral axillary scale absent or rudimentary; no lip groove . . . . . *Liza* Jordan & Swain

#### *Myxus* Günther, 1861b

*Myxus* Günther, 1861b: 466. Type species *Myxus elongatus* Günther 1861b.

*Trachystoma* Ogilby, 1888: 614. Type species *Trachystoma multidentis* Ogilby 1888.

DISTRIBUTION. S Australia and S Africa.

DIAGNOSIS. Mouth gape moderately oblique, mid-gape at level of mid-pupil; mouth corner at level of lower third of eye, reaching between verticals from the anterior and posterior nostrils; upper jaw end slightly below line of mouth gape, reaching vertical between posterior nostril and anterior rim of eye; upper lip terminal, thin, not high, without enlarged papillae or crenulations; lower lip thin, directed forward, not permanently folded down at edges, not entire; symphyseal knob high and single, lip groove variable; no

fleshy lobes over end of jaws or between jaw rami. Maxilla curving below tendon flange, visible below mouth corner when mouth closed in some individuals, but not generally; tendon flange 1/5-1/3 down maxilla shaft, well above mouth corner; coronoid process of dentary slender, rising behind mouth corner; mandibular angle acute to a right angle. Teeth labial in both lips, unicuspid, no gap at symphysis; teeth on vomer, pterygoids, palatines and flat tongue. No adipose tissue on face; preorbital massive, filling space lip to eye, distinctly ridged, front edge slightly notched, obscured in large specimens. Nostrils nearer each other than to lip or eye, posterior nearer to eye than anterior to lip and not reaching above level of upper rim of eye; interorbital convex; opercular opening reaching under eye. Gill rakers type 3 or 4.

Upper insertion of pectoral fin at level of upper rim of eye, fin reaching only 1/2-2/3 distance from head to first dorsal fin origin, axillary scale rudimentary or lacking. Pelvic fin origin nearer vertical from pectoral fin origin than to that from the first dorsal fin origin. First dorsal fin origin nearer caudal base than to snout tip; second dorsal fin origin behind origin of anal fin; 3 anal spines in adults; caudal fin deeply forked. Scales ctenoid on breast, ctenoid, pavement ctenoid or cycloid elsewhere; no multicanalliculate scales. No spine on operculum. Stomach with distinct gizzard; pyloric caeca 2 or 6; intestine in 3 or more loops, its length 2-5 times SL.

**REMARKS.** General body form and head are very like those of *Aldrichetta*, but the well-developed gizzard, ridged and notched preorbital, and wholly labial teeth, all place this genus in the Mugilinae. Günther's (1861b) definition was not discriminatory. His type species was known to him only from skins, and he placed several other species in the genus which are now regarded as members of *Mugil*. Besides the 3 species recognised here, 21 species have been allocated to *Myxus*, but most, if not all, have been based on juvenile specimens of either *Mugil* or *Liza*. Mohr (1927) erected 9 species of *Myxus*, all of which have proved to be juveniles of these 2 genera. *Trachystoma* Ogilby, 1888 was established for a single species from E Australia. Schultz (1946) referred the species to *Sicamugil* based on the form of its teeth. But *Myxus petardi* lacks the opercular spine characteristic of *Sicamugil*, and agrees with other species of *Myxus* in the characteristics listed above.

#### KEY TO THE SPECIES OF *MYXUS*.

1. Teeth ciliate, 15 transverse scales, lateral scales 47-50 (E Australia) . . . . . *petardi* Castelnau
- Teeth spatulate, 13 transverse scale rows, lateral scales 43-46 . . . . . 2
- 2(1). Pectoral fin with 16 rays; 2 pyloric caeca (Australia) . . . . . *elongatus* Günther
- Pectoral fin with 18 rays; 6 pyloric caeca (South Africa) . . . . . *capensis* Valenciennes

#### *Myxus capensis* (Valenciennes, 1836)

- Mugil capensis* Valenciennes, 1836: 108(80), Cape coasts.  
*Mugil euronotus* Smith, 1849: pl. 29, fig. 202, Cape of Good Hope; Bleeker, 1860f: 54, Cape of Good Hope; Smith, 1935: 610, fig. 7, pl. 16, fig. E, pl. 17, fig. F, South Africa.  
*Trachystoma euronotus* Schultz, 1946: 393, Durban; Smith, 1935: fig. 5, pl. 16, fig. E, Knysna, River at Port Alfred, Fish R., Buffalo R. Sinkwazi; 1948: 842, fig. 15, Knysna to St Lucia; 1949: 323, fig. 890, Knysna, Port Alfred, Fish R., Buffalo R., Durban, Sinkwazi R.  
*Mugil saliens* Günther 1861b: 443, (part), The Cape; Boulenger, 1916: 85, (part), St James, Chalumnna R., King Williams Town; Barnard, 1925: 307, Table Bay to East London; Pellegrin, 1933: 169, fig. 91, Table Bay, East London; ?Fowler, 1936: 588, Angola. non Risso.  
*Mugil natalensis* Gilchrist & Thompson, 1911: 42, Natal. (?) non Castelnau  
*Mugil auratus* Gilchrist & Thompson, 1917: 312, Natal; Barnard, 1925: 308, Natal, East London. non Risso.

**SYNTYPES.** MNHN A.4643 and A.4700, Cape of Good Hope, coll. Delalande. Examined.

**MATERIAL EXAMINED.** Syntypes and 2 other specimens 183-227mm SL from Knysna and the Cape of Good Hope. BMNH: 1848.2.1.4, 227mm, holotype of *M. euronotus* Smith; 1935.3.27.1, 215mm, Knysna. MNHN: A.4643, 183mm, syntypes of *M. capensis*, Cape of Good Hope, coll. Delalande; A.4700, 205mm, syntype of *M. capensis*, Cape of Good Hope, coll. Delalande.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 9, A III 9, P 18, L<sub>1</sub> 43-45, tr. 13, ped. 9, pect.sc. 11, D<sub>1</sub> sc. 15-16, D<sub>2</sub> sc. 28. Scales ctenoid on breast, pavement ctenoid on lower flanks and dorsally between fins, cycloid elsewhere, short bulbous mucus canals, more abundant on caudal peduncle, above pectoral fin and near pelvic fin. Body robust, head pointed, scale-free to posterior nostrils; interorbital <1.5 times eye diameter; eye diameter equal to snout length. Upper lip almost pointed laterally, lip groove c.1/2 lip length; anterior mandibular pores large, just behind symphysial groove; 3 obscure pairs behind. Rami of lower jaw curving. Teeth unicuspid, wide-crowned, tips strangled by indentations of shaft; in a single row in both lips. Mouth corner on vertical from posterior nostril, preorbital reaching 2/3 up upper lip, slightly above line joining midpoints of posterior and anterior nostrils. Anterior nostril, with marked cutaneous rim, extending slightly below

vertical span of posterior nostril. Gill rakers short, type 4.

Pectoral fin reaching posterior iris when laid forward, well short (by c.2/3 its own length) of the origin of the first dorsal fin when laid back; pelvic fin tip reaching vertical from base of sp. 2 of first dorsal fin; axillary scale reaching c.1/2 along pelvic spine. Sp. 1 of first dorsal fin longer than sp. 2; sp. 4 weak, not nearly reaching vertical from tip of sp. 3 when fin raised; axillary scale reaching c.1/4 along membrane behind sp. 4. Second dorsal fin origin on vertical c.1/3 along anal fin base; anal fin about same height as second dorsal, both higher than first dorsal; second dorsal and anal fins lightly scaled. Intestinal length 3 times SL; pyloric caeca 6.

DISTRIBUTION. South Africa.

REMARKS. The original descriptions of *Mugil capensis* and *Mugil euronotus* were incomplete. The situation was confused when Smith (1849) figured and described as *M. capensis* a species now recognised as *Liza tricuspidens*. Günther (1861b) had the type of *M. euronotus* before him and 2 specimens attributed to *M. capensis*. One of the latter was in a bad state of preservation and the other 2 were stuffed skins. Günther mentioned the difficulty of assessing form from the stuffed specimens, but from their general appearance he ascribed both to *Mugil saliens* Risso, a designation followed by South African workers until Smith (1935) recognised these South African fish as *Mugil euronotus*.

The description of *Mugil natalensis* given by Gilchrist & Thompson (1911) fits this species. The description by Castelnau (1861) could equally well describe *Liza dumerili*. This species is separated geographically from its congeners. Its 6 pyloric caeca might suggest that *M. capensis* is not closely related to the Australian species with 2. In dentition, general body form and other features the 3 have much in common.

### *Myxus elongatus* Günther, 1861b

*Myxus elongatus* Günther, 1861b: 466, Hobson's Bay, Port Jackson; 1880b: 33, Mary R.; Kner 1865: 230, Sydney; Macleay, 1880: 426, Hobson's Bay, Port Jackson; Ogilby, 1893: 128, pl. 33, NSW; 1897a: 77, Derwent R.; Tosh, 1903: 3, pl. 1, fig. 4, Wide Bay, Moreton Bay; Stead, 1906: 79, NSW; 1908: 15, NSW; Stead, 1906: 79, NSW; 1908: 15, NSW; McCulloch, 1921: 49, NSW; Waite, 1921: 84, fig. 27, SAustralia, 1923: 108, SAustralia; Lord & Scott, 1924: 48, Tasmania; Mohr, 1927: 153, Quotes; Thomson, 1954: 113, fig. 12, New Hebrides, Funafuti, Lord Howe Island, Noosa R., Myora, Cowan Cowan, Southport, Stradbroke Is., Caloundra, Coolon gatta, Tweed heads, Bellenger R., Richmond R., Bruns-

TABLE 4. Biometrics of *Aldrichetta* and *Myxus* spp. \* secondary radii, # also small scattered patches on lip. Abbreviations as in tables 2 and 3 plus PC = pyloric caeca.

Species	<i>A. forsteri</i>	<i>M. capensis</i>	<i>M. elongatus</i>	<i>M. petardi</i>
Scale radii	8-10	5-8	8-12 (4*)	8-12
Depth (%SL)	21.6-24.0	24.0-25.6	22.0-23.5	22.5-27.8
HL (%SL)	23.0-25.5	24.7-25.2	25.2-26.3	21.2-24.0
HW (%HL)	54.0-56.0	70.0-72.0	65.0-70.0	60.0-65.0
IO (%HL)	36.0-38.0	39.3-41.2	39.3-41.2	47.0-49.0
ED (%HL)	12.6-21.5	23.0-23.7	24.8-25.9	22.0-23.5
SnL (%HL)	25.0-26.0	25.0-23.7	26.2-27.5	25.0-26.0
ULH (%HL)	40.5-2	54.5-5	48.5-5	55.0-5
MW/ML	1.1-1.3	1.8-2	1.4-1.7	1.3-1.7
PL (%HL)	75.0-60.0	69.0-73.0	67.5-60.0	60.0-60.0
PH (%PL)	30.0-33.0	36.5-37.0	28-26.0	45.0-48.0
VL (%PL)	64.0-65.0	84.2-89.0	80.5-85.0	92.0-100.0
VAX (%VL)	40.0-41.0	34.0-3.5	37.0-25	28.0-30.0
Ped (%D)	40.0-42.0	30-34.2	47.0-5	25.8-47.5
TR(UL)	1	1		
TR(UL)	1	1	1#	1
LES	13-15	10-10	10-21	10-21
FES	17-22	9-20 (1)	17-22	10-13
Sp. 2/Sp. 1	5	2-3	2.5-2.6	3.5-3.5
Sp. 3/Sp. 2	1-5	1	1.5-1.5	2-2.5
CC (Auss.)	19-24 24=	42-45/ 60-70	35-42/ 60-68	28=
PC	3-4 35-45			
PC	2	1	1	

wick Heads, Tuggerah Lakes, Mona Vale, Sydney, Watsons Bay, Port Jackson, Merimbula, Yamba, Purrwater, Mandurah, Scarborough (WA); Scott, 1962: 133, fig., SAustralia; Marshall, 1964: 405, pl. 35, fig. 384, S Queensland; Gomon et al 1994: 663, S Australia.  
*Mugil crenidens* Kner, 1865: 229, pl. 9, fig. 4, 'New Holland'; Macleay, 1880: 48, Port Jackson.  
*Myxus crenidens* Steindachner, 1866: 461, Port Jackson.  
*Mugil ventriosus* Castelnau, 1875: 32, non Richardson.

HOLOTYPE. BMNH 1846.6.17.23, Hobson's Bay, pres. Earl of Derby. Examined.

MATERIAL EXAMINED. Holotype, paratype and 20 specimens 48-240mm. BMNH: 1846.6.17.23, 232mm, holotype of *M. elongatus*, Hobson's Bay, pres. Earl of Derby; 1846.10.22.16, 234mm, paratype of *M. elongatus*, Port Jackson, coll. Gould; 1860.5.25.16, 48mm, Port Jackson; 1883.1.29.57-58, 230 & 240mm, NSW; 1890.9.23.94, 228mm, Port Jackson. MNHN: A.1244, 3 spec. 65-68mm, Nicol Bay, NHM: 9299-9300, 165mm SL, holotype of *M. crenidens*, New Holland, coll. Kner. AM: A.5940-1, 192 & 225mm, Tasmania; 14619, 198mm, Lord Howe Island; 1.5586-9, 4 spec. 206-237mm, Lord Howe Is. 1.6994, 155mm, Mandurah; 1.9511, 182mm, Sydney; 18998,



189mm, Tweed Heads, QM: I.1487, 223mm, Noosa R., LSNM: 47770, 234mm, Lord Howe Is.; 47773, 236mm, Lord Howe Is. WAM: 107, 148mm, Mandurah.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 16, L1 43-46, tr. 13, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 15-16, D<sub>2</sub> sc. 29-30. Scales cycloid, except ctenoid ventrally; moderately long mucus canals on comparatively few scales. Body moderately slender, head pointed, scale-free to posterior nostrils; upper contour straight; interorbital 1.5 times eye diameter; eye diameter shorter than snout; no adipose tissue on face. Upper lip median height 1/5 eye diameter. Teeth in single row in upper lip, in lower continuous row on lip edge and in patches on each side well in from lip edge, just in front of coronoid process; upper teeth wide-crowned, strangulated tips curving inwards; lower teeth long and narrow with short tips curving from shafts; broad tooth plates on lateral edges of tongue and a narrow median plate opposite pterygoids. Mouth corner on vertical from posterior nostril; tip of upper jaw very slightly above line of gape, unusually far behind mouth corner (distance almost 1/3 length of lower lip). Upper end of preorbital reaching level 1/2 up upper lip and on line joining midpoints of posterior and anterior nostrils; anterior nostrils with cutaneous rim higher posteriorly, wholly within vertical span of posterior. Gill rakers long type 3.

Pectoral fin reaching posterior iris when laid forward, falling short of origin of first dorsal by 2/3 its own length when laid back. Pelvic fin tip reaching almost to vertical from first dorsal fin origin; axillary scale reaching >1/2 along pelvic spine. Sp. 2 of first dorsal fin longer than sp. 1; sp. 4 not reaching beyond vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2 to 2/3 along membrane behind sp. 4. Second dorsal fin origin on vertical about 1/3 along anal fin base; anal fin higher than subequal first and second dorsal fins; second dorsal and anal fins scaled anteriorly and along base. Intestine 2-5 times SL, increasing with size; pyloric caeca 2.

**DISTRIBUTION.** Coasts and estuaries of Australia, other than the tropical north, and Lord Howe Is.

**REMARKS.** This species may well be the *Mugil aeneus* of Valenciennes (1836), but the type specimen cannot be found. The description given by Valenciennes could equally apply to *Aldrichetta forsteri* or to *Liza argentea*. McCulloch (1929) placed *Cestraeus norfolcensis* Ogilby in the synonymy of this species, but the characters of the type of *C. norfolcensis* do not tally with this

species, as pointed out by Thomson (1954). Blanc & Hureau (1972) list Castelnau's specimens of *Mugil ventricosus* as syntypes. It is not clear from the text of Castelnau (1875) that a new species was being erected. He may well have been referring to *M. ventricosus* Richardson. *Myxus elongatus* is readily distinguished from its Australian relative, *M. petardi* by the scale count and by the nature of the teeth in the upper lip.

### *Myxus petardi* (Castelnau, 1875)

*Mugil breviceps* Steindachner, 1866: 459, pl. 1, fig. 1, Port Jackson, non Valenciennes.

*Liza breviceps* Toshi, 1903: 3, pl. 2, fig. 4, Nerang R., non Valenciennes.

*Mugil petardi* Castelnau, 1875: 32, Roebuck Bay, Richmond R.

*Mugil petardi* Macleay, 1880: 42, NSW; 1881: 48, Richmond R.

*Trachystoma petardi* Ogilby, 1908: 28, reference; McCulloch, 1921: 49, New South Wales; Schultz, 1946: 392, Clarence R.; Thomson 1954: 111, fig. 11, Hawksbury R. at Sackville, Nepean R. at Penrith, Georges R., Port Macquarie, Clarence R., upper Albert R., upper Logan R., Pine R., upper Noosa R., Richmond R.; Marshall, 1964: 406, pl. 53, fig. 385, S Queensland.

*Trachystoma multident* Ogilby, 1888: 614, Karuah, Port Stephens.

*Mugil parviceps* Waite, 1904: 22, NSW.

**SYNTYPES.** MNHN A.5130, Richmond R., coll. Castelnau. Examined.

**MATERIAL EXAMINED.** 2 syntypes and 19 specimens, 100-355mm SL. BMNH: 1864.7.6.71, 170mm, Hawksbury R.; 1864.7.22.50-1, 100 & 210mm, locality unknown; 1871.4.14.2, 227mm, locality unknown; 1890.9.23.98, 320mm, Port Jackson; 1914.8.20.258-261, 4 spec. 116-355mm, Nepean R. MNHN: A.5130, 118 & 146mm, syntypes of *M. petardi*, Richmond R., coll. Castelnau. AM: L.333, 188mm, Georges R.; L.7648, 209mm, Clarence R.; L.13007, 267mm, Hawksbury R.; L.13020-22, 3 spec. 122-180mm, Nepean R. at Penrith, QM: L.4958-67, 10 spec. 120-188mm, Nerang R.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 15 L1 47-50, tr. 15, ped. 11, pect. sc. 12, D<sub>1</sub> sc. 18, D<sub>2</sub> sc. 32. Scales ctenoid, mucus canals short, shallow, mostly on peduncle and lower flank, few elsewhere. Body slender in young, deepening with age; head pointed, scale-free to anterior nostril; interorbital c. 1.5 times eye diameter; eye diameter slightly shorter than snout; no adipose tissue on face. Upper lip median height c. 1/4 eye diameter; lip groove short, c. 1/6 length of lip; anterior mandibular pores large, directly behind symphyseal groove, slightly more than breadth of symphyseal knob apart; 4 other pairs behind, last pair inconspicuous. Single row of teeth in each lip, fine and pointed, scarcely emergent in some, often missing in large fish. Mouth and tongue membranes with fine papillae. Mouth corner on vertical from anterior nostril; tip of lower jaw

slightly below line of gape, reaching well behind mouth corner (c. 1/4 length of lower lip); upper end of preorbital at level 1/2 up upper lip, on line joining midpoints of posterior and anterior nostrils; anterior nostrils with cutaneous rim higher on posterior side, extending below vertical span of posterior nostril. Gill rakers short, type 3.

Pectoral fin reaching anterior half of eye when laid forward failing to reach origin of first dorsal fin by 1/3-1/2 its own length. Tip of pelvic fin reaching vertical from sp. 3 of first dorsal fin, axillary scale reaching 1/3-1/2 pelvic spine length. Sp. 1 of first dorsal fin equal to or slightly greater than sp. 2; sp. 4 variable, reaching behind tip of sp. 3 when fin raised in some specimens; axillary scale reaching c. 1/3 along membrane behind sp. 4. Second dorsal fin origin on vertical about 1/2 along anal fin base; anal fin higher than subequal dorsal fins; second dorsal and anal fins scaled anteriorly. Intestine 5.5 times SL; pyloric caeca 2.

**DISTRIBUTION.** Rivers of E Australia from Georges R. in New South Wales to Burnett R. in Queensland, usually in freshwater.

**REMARKS.** *M. breviceps* of Valenciennes came from Senegal. Steindachner may have applied the name to this Australian fish in ignorance of the prior use of the name. Distinction of this species from others of the genus is provided in the key.

### *Chaenomugil* Gill, 1863

*Chaenomugil* Gill, 1863: 169. Type species *Mugil proboscideus* Günther, 1861b.

*Neomyxus* Steindachner, 1878: 384. Type species *Myxus* (*Neomyxus*) *scleteri* Steindachner, 1878.

**DISTRIBUTION.** Pacific Ocean

**DIAGNOSIS.** Mouth gape markedly oblique, mid-gape at level of upper rim of pupil or higher; mouth corner 1/5-1/2 eye diameter below level of lower rim of eye, reaching vertical from anterior nostrils or a little behind; upper jaw end above line of gape at level of lower rim of eye. Upper lip terminal, thick and high, without enlarged papillae or crenulations; lower lip thick, its edge permanently turned down; lip groove c. 1/3 lower lip length; no fleshy lobes over ends of jaws or between jaw rami. Adipose tissue lacking on the face; maxilla slightly mobile; tendon flange slightly above midpoint of shaft at about eye level, not visible below mouth corner when mouth closed; coronoid process of dentary slender, rising behind mouth corner; mandibular angle acute. Teeth labial, close-packed in several rows, long-stemmed with divided tips; no teeth on vomer or palatines, but present on pterygoids

and flat tongue. Preorbital fairly massive, filling only c. 3/4 space lip to eye, distinctly ridged, not notched on front edge. Nostrils nearer each other than to lip or eye, posterior nearer eye than anterior to lip; posterior nostril extending above level of upper rim of eye; anterior nostril wholly within vertical span of posterior. Interorbital only slightly convex, opercular opening reaching under eye. Gill rakers type 2 or 4.

Upper insertion of pectoral fin at level of upper third of eye; no pectoral axillary scale; pelvic fin origin nearer vertical from pectoral fin origin than to that from first dorsal fin origin. First dorsal fin origin nearer caudal base than to snout tip; second dorsal fin origin in vertical 1/3-1/2 along anal fin base; 3 anal spines in adult; caudal fin deeply forked. Scales cycloid or ctenoid, some multicanalliculate. No spines on operculum. Stomach with a gizzard; 2 pyloric caeca. Intestines 2-5 times SL.

**REMARKS.** Immediately distinguishable from other species with thick lips by the down-turned lower lip and the short mouth gape, and from all other mugilids by the nature of the long-stemmed teeth with divided tips. Schultz (1946) maintained *Neomyxus* separate from *Chaenomugil* on the basis that the lower lip in *Chaenomugil* was 'directed' rather than 'folded' down. But when specimens of each are compared side by side their mouth structure is so alike that it can only be concluded that they are closely related.

### KEY TO THE SPECIES OF *CHAENOMUGIL*.

1. Scales ctenoid, teeth bicuspid (W coast of America from California to Peru) . . . . . *probovulus*  
Scales cycloid, teeth tricuspid (Central Pacific, Hawaii to New Caledonia) . . . . . *leuciscus*

### *Chaenomugil leuciscus* (Günther, 1871)

*Myxus leuciscus* Günther, 1871: 666, pl. 65A, Rarotonga; 1877: 220, pl. 121, fig. C, Rarotonga, Raiatea, Tahiti, Loyalty islands; Waite, 1897: 191, Funafuti, Ellice islands; Seale, 1906: 15, Makatea, Paumotu, Mohr, 1927: 195, (quotes); Fowler, 1927: 10, Tongareva; 1928: 127, Hawaii.

*Neomyxus leuciscus* Masuda et al, 1984: 120, p. 347, fig. F, Japan.

*Mugil trichalus* Vaillant & Sauvage, 1875: 287, Hawaii.

*Myxus* (*Neomyxus*) *scleteri* Steindachner, 1878: 384, Kingmill Is., (Hawaii); Schultz, 1946: 386, Niuafoa Is., Phoenix Is., Swains Is., Wake Is., Mikemo Is., Baker Is., Guam, Ellis Is., Tongareva, Manga Rive, Marquesas, Hawaii.

*Myxus caddwelli* Fowler, 1900: 524, pl. 19, fig. 4, Samoa.

*Myxus caddwelli* Fowler, 1903: 747.

*Chaenomugil nauticus* Bryan & Herre, 1903: 127, Marcus Is.

*Chaenomugil chaptalia* Jenkins, 1904: 438, Hawaii; Jordan & Evermann, 1905: 139, fig. 48, Honolulu, Hilo, Kailua;

Herre, 1936b: 99, Marquesas, Tahiti, non Eydoux & Souleyet.

*Neomyxus chaptalii* Kendall & Goldsborough, 1911: 260, Funafuti, Guam, Arkin Atoll, Makeroa; Fowler, 1927: 10, Palmyra, Tongareva, Baker Is., Christmas Is., Washington Is.; 1928a: 127, Honolulu, Hilo, Pago Pago, Guam, Raiatea, Nukahiva, Latsan, Marcus Is., Johnston I., Oahu, Makeroa, Wake Is., Mangareva, Funafuti, Smith Is.; 1932b: 8, Marquesas; Schultz, 1943: 79, Swains Is., Hull Is., Enderbury Is., Tau; 1953: 315, pl. 24, figs A-B, Bikini Atoll, Eniwetok, Rongelap, Rongarik, Saipan, Guam; non Eydoux & Souleyet.

*Myxus pacificus* Jordan & Evermann, 1905: 141, Hawaii, non Steindachner.

*Mugil cephalus* Seale, 1906: 17, Nukahiva, non Linnaeus.

HOLOTYPE. BMNH 1871.9.13.135, Rarotonga, coll. Schmeltz. Examined.

MATERIAL EXAMINED. Holotype and 19 specimens, 73-214mm SL. BMNH: 1871.9.13.135, 100mm. Holotype of *M. leuciscus* Rarotonga, coll. Schmeltz; 1873.4.3.5, 214mm, Tahiti; 1877.7.24.10, 85mm, Loyalty Islands; 1877.7.24.13 198mm, Tahiti. MNHN: 8073, 3 spec. 7-90mm, syntypes of *M. trichilus*, Honolulu, coll. Ballieu; 8074, 3 spec. 73-77mm, syntypes of *M. trichilus*, Honolulu, coll. Baillieu; A.467, 2 spec. 83 & 160mm, syntypes of *M. trichilus*, Hawaii, coll. Baillieu. AM: IA.3537, 180mm, Ellice Island. BPBM: 10267, 7 spec. 58-70mm, Tuamotu Islands.

DESCRIPTION. D<sub>1</sub> IV D<sub>2</sub> i 9, A III 10, P 16, LL 42-45; tr. 13, ped 11, pect sc. 10, D<sub>1</sub> sc. 14, D<sub>2</sub> sc. 28. Scales cycloid, moderately long sinuous canals, occasional breast scale with 2 canals. Body robust, head pointed, scale-free to 1/4 distance from snout to anterior nostrils; interorbital gently convex, less than twice eye diameter; eye diameter shorter than snout. Upper lip projecting 1/3 eye diameter, its median height 1/4 eye diameter or more, lower lip thick, curled down at edge in some specimens, for part of distance in others; anterior mandibular pores large, under symphyseal symphysis, 3 smaller pairs of pits behind, rear-most opposite jaw end. 2-3 rows of teeth in both lips, glistening white, long-stemmed, curling sharply at distal ends into tricuspid crown; a few uncarved bifid teeth laterally in lower lip of large specimens. Mouth corner on vertical from posterior nostril Preorbital front edge smooth, straight in central portion, curving above and below, upper end reaching level just above mid-gape and on line joining midpoints of posterior and anterior nostrils. Gill rakers long, type 4.

Pectoral fin reaching anterior rim of eye when laid forward, not quite to the origin of the first dorsal fin when laid back, >1/2 along pelvic fin but not passing tip of pelvic spine. Pelvic fin tip barely reaching vertical from first dorsal fin origin, axillary scale reaching c.1/2 along pelvic spine. Sp. 2 of first dorsal fin longer than sp. 1; sp. 4 short, not nearly passing vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2

TABLE 5. Biometrics of *Chaenomugil* spp. Abbreviations as in Tables 2-4.

Species	<i>C. proboscideus</i>	<i>C. leuciscus</i>
Scale radii	7-9	11
Depth (%SL)	26.0-28.0	24.7-26.9
HL (%SL)	23.0-25.0	24.6-26.0
HW (%HL)	69.0-70.0	66.0-66.5
IO (%HL)	54.1-55.5	46.0-46.5
ED (%HL)	29.0-29.2	22.8-23.5
SnL (%HL)	26.2-28.0	28.6-28.8
ULH (%HL)	14.0	7.25-7.5
MW/ML	0.45-0.75	0.5-0.9
PL (%HL)	95.0-98.0	81.0-83.0
PB (%PL)	25.0-26.0	24.0-28.3
VL (%PL)	74.0-75.0	80.0-82.0
VAX (%VL)	45	38.2-38.5
Ped (%D)	45.0-46.0	47.3-48.5
TR(UL)	6-8	2-3
TR(LL)	6-8	2-3
LES	16-18	14-16
FES	0	0
Sp.2/Sp.1	2.5	2.3
Sp.3/Sp.2	1.5	1.7
GR	12-28/24-3	40-64/50-78
PC	2	2

along membrane behind sp. 4. Second dorsal fin origin on vertical 1/3 along anal fin base; tips of anterior rays variably reaching or not reaching behind tips of posterior rays. Anal fin as high as second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins lightly scaled, more densely anteriorly. Intestine length nearly 5 times SL.

DISTRIBUTION. Central Pacific islands Hawaii to Samoa.

REMARKS. This species has been attributed to *Neomyxus chaptalii* (Eydoux & Souleyet), but the holotype of *N. chaptalii* (MNHN 8100) is a juvenile *Mugil cephalus*, whose lower lip happens to be reflected laterally. The original description of *M. chaptalii* included a fin formula of D<sub>2</sub> 2/8, A III 9 which does not accord with either *M. chaptalii* or *M. cephalus*. But the types of *M. chaptalii* all have fin counts typical of *M. cephalus*. Fowler (1928a) examined the types of *C. nauticus* and equated them with his *N. chaptalii* (= *C. leuciscus*). Fowler (1928a) also stated that his *M. caldwelli* was *M. trichilus*. But his own brief description of the fish he identified by

that name sounds more like *Valamugil engeli*. Jordan & Seale (1906) followed by Fowler (1936) referred *M. pacificus* Steindachner to this species. But *M. pacificus* has A III and LI 38-40 as well as a thin upper lip. It may well have been a juvenile *M. cephalus*, but the type has been lost (Wahlert, 1955). Fowler's descriptions of *Myxus* or *Liza caldwelli* are not full enough to be identified with certainty.

### ***Chaenomugil proboscideus* (Günther, 1961b)**

*Mugil proboscideus* Günther: 1861b: 459, Isle of Cordova, Nicaragua, west coast of central America.

*Chaenomugil proboscideus* Gill: 1864: 166 (new generic name); Jordan & Swain, 1884: 272, W coast, central America, Nicaragua; Jordan & Culver, 1895: 424, Sinaloa; Jordan & Evermann, 1896: 816, Mazatlan, Cordova, Panama; 1902: 256, fig., Mazatlan, Cordova; Gilbert & Starks, 1904: 61, Panama Bay; Meek & Hildebrand, 1923: 281, Mazatlan to Panama Bay; Fowler, 1938b: 293, Chatham & Albemarle Islands; Morrow, 1957: 26, Peru. *Chaenomugil proboscideus* (Misprint) Schultz, 1946: 285, Clarion Is, Socorro, Chatham Is., Albemarle Is., Pearl Is., Cupica Bay, Culebra Is., Mazatlan, Panama.

SYNTYPES. BMNH 1860.7.21.22 & 1869.8.13.4, Cordova & Panama, coll. Skinner. Examined.

MATERIAL EXAMINED. Syntypes 36 specimens, 11-180mm SL, W coast of central America and Nicaragua.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 16, LI 42-44, tr. 13, ped. 9, pect. sc. 13, D<sub>1</sub> sc. 14, D<sub>2</sub> sc. 27. Scales ctenoid, moderately long mucous canals, variously angled across scales; no multicannaliculate scales; some secondary scalation dorsally. Body robust, head pointed, scale-free to anterior nostrils; interorbital less than twice eye diameter; slightly convex; eye diameter longer than snout length. Upper lip projecting distance equivalent to 1/2 eye diameter, unusually high laterally; lower lip thick, its edge curled down medianly in all specimens and laterally in some; symphyseal knob low, broad. Anterior mandibular pores large, well back from symphyseal groove; 3 smaller pairs behind. Multiple rows of teeth in both lips, glistening white, long stemmed, curving slightly to strongly bifid tips at right angles to stems. Mouth corner on vertical between nostrils; tip of upper jaw above level of mouth gape, nearly reaching vertical from anterior rim of eye; front edge of preorbitals smooth, gently convex, upper end slightly above mid-gape level, on line joining midpoints of posterior and anterior nostrils. Gill rakers short, type 2.

Pectoral fin reaching posterior nostril when laid forward, not quite to vertical from origin of first dorsal fin, c.3/4 along pelvic fin (past tip of pelvic spine) when laid back; pelvic fin tip reach-

ing vertical from base of sp. 2 of first dorsal fin; axillary scale reaching > 1/2 along pelvic spine. Sp. 2 of first dorsal fin slightly longer than sp. 1; sp. 4 weak and thin, not nearly reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c.1/3 along membrane behind sp. 4. Second dorsal fin origin on vertical c.1/2 along anal fin base; tips of anterior rays not nearly reaching behind tips of posterior rays; anal fin as high as second dorsal, both higher than first dorsal; second dorsal and anal fins densely scaled and sheathed at base. Intestine 3 times SL.

DISTRIBUTION. West of America from Baja California to Peru.

REMARKS. *C. proboscideus* is geographically separated from *C. leuciscus* which inhabits the central Pacific Ocean and Oceania. The ctenoid scales and bicuspid teeth contrast with the cycloid scales and tricuspid teeth of *C. leuciscus*.

### ***Mugil* Linnaeus, 1758**

*Mugil* Linnaeus, 1758: 316. Type species *Mugil cephalus* Linnaeus, 1758; Schultz, 1946.

*Cephalus* Lacépède, 1800: 589. Type species *Mugil cephalus* Linnaeus, 1758.

Arnott Gistel, 1845: Type species *Mugil cephalus* Linnaeus, 1758.

Ellis Gistel, 1848: 109. Type species *Mugil cephalus* Linnaeus, 1758.

*Queronana* Jordan & Gilbert, 1883b: 588. Type species *Myxus bimaculatus* Günther, 1861b.

*Xenomugil* Schultz, 1946: 386. Type species *Mugil thalassoma* Jordan & Evermann, 1896.

DISTRIBUTION. All except Arctic and Antarctic seas.

DIAGNOSIS. Mouth gape oblique, mid-gape at level of upper 1/3 of pupil; mouth corner at or slightly below level of lower rim of eye, reaching vertical between posterior nostril and anterior rim of eye; tip of upper jaw reaching vertical somewhere from the midpoint between the posterior nostril and anterior eye rim and a point under the anterior iris. Upper lip terminal, thin to moderately thick, of moderate height, without enlarged papillae or crenulations; lower lip thin, not permanently folded down at edge; symphyseal knob high, single, with a shallow symphyseal groove beneath; lip groove 1/6-1/3 length of lower lip; no fleshy lobes over jaw ends or lying freely between lower jaw ramus. Maxilla moderately mobile, tendon flange c.1/2 down shaft, above mouth corner; shaft curving gently in one plane to jaw end, visible above premaxilla, but not visible below or behind mouth corner when mouth closed. Coreonoid process of dentary slender, rising behind mouth corner; mandibular an-

gle acute in young of all species, becoming obtuse with age in some. Teeth labial, large in upper lip, outer row unicuspid, inner rows, when present, unicuspid or bicuspid according to species; auxiliary rows not so common in lower lip; teeth on pterygoids and tongue of some species, but not on vomer or palatines. Tongue flat or domed, sometimes with low median ridge, but never keeled. Adipose tissue on face intruding over eye to pupil. Preorbital slender, not notched, filling space lip to eye, or nearly so; with strong oblique ridge. Nostrils nearer lip and eye than to each other, posterior reaching above level of upper rim of eye, or just below; anterior nostril with slight cutaneous rim, either wholly below, or slightly overlapping, vertical span of posterior. Interorbital flat or nearly so. Opercular opening reaching under eye. Gill rakers type 3..4 or 5.

Upper insertion of pectoral fin at level of upper rim of eye; with marked axillary scale. Pelvic fin origin nearer vertical from pectoral fin origin than to that from first dorsal fin origin; first dorsal fin origin variable; second dorsal fin origin on vertical variously from just behind anal fin origin to 1/2 along anal base; 3 anal spines in adult, 2 in young. Scales pavement ctenoid or cycloid; a secondary squamation of small scales present in some species. No spines on operculum. Stomach with distinct gizzard; intestine 3-5 times SL; pyloric caeca 2.

REMARKS. The genus is characterised by slender maxilla, visible above the almost straight premaxilla (but not visible below the mouth corner when the mouth is closed), the tip of the jaw end on the line of the mouth gape, the adipose eyelid, the pointed axillary scale, the thin-edged lower lip and the absence of an opercular spine. *Mugil* has often been used as a catch-all genus. Jordan & Swain (1884) erected *Liza* as a subgenus characterised by the lack of an adipose eyelid, a criterion which held good for Atlantic mullet, but which broke down when other characteristics are compared in Indo-Pacific species. Consequently many authors fell back on using *Mugil* for all (e.g., Weber & De Beaufort, 1922). Schultz (1946) defined *Mugil* (sensu stricto) and also differentiated other genera. An extreme member of the group, *M. thuburni* was placed in monospecific *Xenomugil*, by Schultz (1946). This species has 3 unusual characteristics: 1, the upper lip remains high throughout its length instead of narrowing posteriorly and consequently it hangs so as to obscure the hind part of the lower lip; 2, the level of the mouth corner and the tip of the upper jaw are well below the level of the lower rim of

the eye, whereas in typical *Mugil* they are only slightly below this level; and 3, the lower lip was reported to be folded down at the edge. But of the 12 specimens in the British Museum, only 1 has the lip completely turned down so that the teeth on its reflected edge lie parallel with the upper lip, 7 have the lip reflected to an intermediate angle, 3 have the lip reflected only on 1 side or over part of its length, 1 has the lower lip in a normal position. Of the 4 specimens in the Paris Museum, 3 have reflected lips, but 1 has the lip horizontal. Occasional specimens of other species of *Mugil* and *Liza* have the lower lip reflected either wholly or in part. Possibly in life all thin-lipped mullet can turn the lower lip down and the appearance in museum specimens may be the result of muscle flexure during fixation. The level of the mouth corner and the height of the posterior lip are examples of anatomical extremes rather than major character differences on which a genus may be erected. *Querimania* was proposed to hold small mullets with only 2 anal spines. The types of *Q. harengus* are small *M. curema*. The generic name has also been applied to species at the 2-spined state of the anal fin.

#### KEY TO THE SPECIES OF *MUGIL*

1. Anal fin III 8 in adults, II 9 in young. . . . . 2  
     Anal fin III 9 in adults, II 10 in young. . . . . 6
- 2(1). Median fins densely scaled; 7 rows of scales on caudal peduncle (Florida to West Indies and Pernambuco) . . . . . *trichodon*  
     Median fins lightly scaled; 9 rows of scales on peduncle . . . . . 3
- 3(2). Lateral scale count 34 or fewer (Cuba to Argentina) . . . . . *Liza*  
     Lateral scale count > 34 . . . . . 4
- 4(3). Inner rows of teeth bicuspid, teeth on pterygoids LI 17-43; on premaxilla and vomer 1-43 and 1-43 respectively  
     Inner rows of teeth unicuspid, pterygoids toothless, LI 16-38 . . . . . 5
- 5(4). First dorsal fin origin nearer caudal base than to snout tip; pectoral laid forward reaching anterior pupil (West Indies, Atlantic shores of North America, Ascension Island). . . . . *curvidens*  
     First dorsal fin origin nearer to snout tip than to caudal base; pectoral laid forward reaching hind edge of pupil (West Africa, Senegal to Angola) . . . . . *capurru*
- 6(1). Transverse scales 14-15; median fins scaled at base and anteriorly (NW coast of Africa). . . . . *capurru*  
     Transverse scales < 14; median fins densely scaled. 7
- 7(6). Pectoral fin laid back reaching behind vertical from first dorsal fin origin (Atlantic & Pacific coasts of tropical America) . . . . . *basiper*  
     Pectoral fin laid back, not reaching behind vertical from first dorsal fin origin . . . . . 5
- 8(7). LI > 40 . . . . . 9  
     LI < 40. . . . . 10



TABLE 6. Biometrics of *Mugil* spp (1). \* continuous series along a curving edge. Abbreviations as in Tables 2-4.

Species	<i>M. bananensis</i>	<i>M. luteocarpus</i>	<i>M. capensis</i>	<i>M. luteus</i>
Scale radii	6-10	9-19	9-17	5-10
Depth (%SL)	25.0-27.0	25.0-25.7	22.8-24.3	24.4-25.3
HL (%SL)	21.0-28.0	24.0-26.0	25.2-31.5	21.1-25.0
HW (%HL)	65.0-66.0	64	51.5-55.5	57.1-58.5
IO (%HL)	16.0-16.2	17.5-18.5	16.0-16.5	16.5-16.5
EL (%HL)	25.5-26.0	24	19.5-20.0	21.5-22.5
SnL (%HL)	25.5-26.0	24	19.5-20.0	21.5-22.5
ULH (%HL)	2.0-7.5	6-4	1.5-5.0	3.5
PL (%HL)	70.0-77.3	73.0-76.5	68.0-72.5	66.5-73.8
PB (%PL)	32.0-34.0	28.0-32.0	32.8-34.8	32.8-33.3
PAX (%PL)	31.7-33.0	30.0-31.1	27.3-30.0	33.3-35.8
VL (%PL)	83.0-85.0	77.1-80.0	71.1-76.5	82.5-85.4
VAX (%VL)	55.0-60.0	57.0-59.1	53.5-54.1	56.1-57.5
Ped (%D)	40.0-41.5	42.6-43.1	40.0-45.4	39.0-44.0
TR(UL)	1	1-2	1	1-2
TR(LL)	2	1	1	1-4
LES	4-8	3-4	29-33*	8-10
LES	8-14	28-31		8-10
Sp.2/Sp.1	2.4-2.5	2.35	3.0	2.1-3.5
Sp.3/Sp.2	1.1-1.4	1.4	1.1	1.1
GR	6-34	12-17	3-27	6-35
GR	30-40	40-50	50-60	48-75
PC	2	2	3	

9(8). Pectoral laid forward reaching anterior pupil (Galahagos) . . . . . *rhoburni*

Pectoral laid forward reaching posterior pupil (Atlantic, Panama to Amazon) . . . . . *medii*

10(8). Upper lip < 7% HL; eye < 26% HL (western Pacific) . . . . . *brunsonetti*

Upper lip > 7.5% HL; eye > 26% HL . . . . . 11

11(10). Pectoral fin < 20% SL; upper teeth wide-crowned (Atlantic and Pacific coasts of Americas, Atlantic coast of Africa, Gambia to Congo) . . . . . *luteus*

Pectoral fin > 20% SL; upper teeth narrow-crowned . . . . . *luteus*

Pectoral fin > 20% SL; upper teeth narrow-crowned (W coast of Mexico and adjacent islands) . . . . . *luteus*

### *Mugil bananensis* (Pellegrin, 1928)

*Mugil brasiliensis* Troschel, 1866: 212, C. Verde Is.; Osorio, 1898: 198 (Part), C. Verde Is. non Agassiz & Spix.

*Myxus bananensis* Pellegrin, 1928: 56, Banana, Congo R.

*Mugil bananensis* Cadenat, 1954: 586, 589, Gulf of Guinea to Angola, Sierra Leone, Senegal; 1955: 60, Gulf of Guinea to Angola, Sierra Leone, Senegal; Poll, 1959: 261, fig. 89, C. Verde Is.

HOLOTYPE. Mus. R. Afr. Centr. 90, Pellegrin, Congo R. mouth. Examined.

MATERIAL EXAMINED. Holotype and 54 specimens, 21-158mm SL from Sierra Leone, Cape Verde Islands, Senegal, Nigeria and the Congo. BMNH: 1847.4.4.6, 136mm, R. Niger; 1847.8.4.6, 45mm, R. Niger; 1879.5.14.499, 122mm, St. Jago, C. Verde Is.; 1899.1.27.47-8, 127 & 137mm, Banana, Congo R.; 1900.6.28.244, 3 spec. 162-212mm, St. Louis, Senegal; 1905.5.12.5, 134mm, Cabinda, Angola; 1930.8.26.67, 92mm, 8 miles W of Accra; 1937.4.19.28, 158mm, Lagos; 1939.7.12.37, Keta, Ghana; 1949.1.26.1-7 22 spec. 158-215mm, Ladege, Lagos; 1958.9.18.280-286, 7 spec. 27-290mm, Bonthe, Sierra Leone, MNHN: 1967-152, 13 spec. 31-85mm, Songolo estuary, Congo R.; 1967-253, 3 spec. 30-45mm, Laeme estuary, Congo R. Mus. R. Afr. Centr. 90: 90mm, holotype of *M. bananensis*, Banana, Congo R. coll. Pellegrin.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 8, L I 36-38, tr. 11-12, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 13, D<sub>2</sub> sc. 23-24. Scales pavement ctenoid, long thin mucus canals, no multicanalicular scales; secondary squamation present. Body moderately robust, head rounded, scale-free 1/2 way to anterior nostril; interorbital less than twice eye diameter, slightly convex; eye diameter equal to snout length; median height upper lip < 1/3 eye diameter; lip groove slightly > 1/3 length of upper lip; anterior mandibular pores at rear of symphyseal groove, c. 1.5 times breadth of symphyseal knob apart; other pores obscure. Rami of lower jaw curving; mandibular angle acute. Slightly curving setiform teeth in one row in upper lip, spaced more than tooth's breadth apart; spaced row of ciliiform teeth on lower lip, a second row at base of upper lip, often lost in large specimens. Teeth lacking on pterygoids and flat tongue. Tip of upper jaw reaching vertical midway between posterior nostril and anterior rim of eye. Preorbital filling only 1/2 space lip to eye; upper end reaching level 1/2 up upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostrils reaching above level of upper rim of eye; anterior nostril wholly below vertical span of posterior. Gill rakers long, type 3.

Pectoral fin reaching to hind rim of eye when laid forward, not nearly to vertical from origin of first dorsal fin and c. 1/2 along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale reaching c. 3/4 along pelvic spine. First dorsal fin origin nearer snout tip than to caudal base; sp. 2 longer than sp. 1, sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/3 along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal and second dorsal fins lightly scaled anteriorly and along base. Caudal fin deeply forked.

DISTRIBUTION. W coast of Africa from Senegal to Angola.

**REMARKS.** Formerly confused with *M. cephalus* this species differs in the few small teeth in the lower lip, the relatively few gill-rakers and the low scale count, particularly the fewer transverse rows. From *M. curema*, whose range overlaps, it differs in the scale count, in the longer upper teeth, shorter lower teeth, and in the character of the gill rakers. In general appearance *M. curvidens* from the western Atlantic, is very like *M. bananensis* but in the former the teeth are close-set, the pectoral fin is relatively long and the origin of the first dorsal fin differs. The long upper teeth led Pellegrin to describe this species as a *Myxus*. His original description gave the scale count as 33. The type has several scales missing, but had 35 scales on each side.

#### *Mugil broussonnetii* Valenciennes, 1836

*Mugil broussonnetii* Valenciennes, 1836: 11/(87), South Pacific; Günther, 1861b: 453, South Seas; 1877: 218, South Seas, Duncker & Mohr, 1925: 131, New-Pomerania. *Mugil macrolepidotus* Richardson, 1846: 249, China, non Rüppell.

**HOLOTYPE.** MNHN A, 3656, South Seas, coll. Banks. Examined.

**MATERIAL EXAMINED.** 2 holotypes, BMNH: 1847.5.10.12, 148mm, holotype of *M. macrolepidotus*, China, coll. Richardson. MNHN: A.3656, 196mm, holotype of *M. broussonnetii*, South Seas, coll. Banks.

**DESCRIPTION.** D: IV D<sub>2</sub>: i 8, A III 9, P. 16-17, L1 36-37, tr. 11, ped. 9, pect. sc. 10; D<sub>1</sub> sc. 9, D<sub>2</sub> sc. 22. Scales feebly ctenoid, long mucus canals, a few scales dorsally with double or Y-shaped canals. Body slender; head pointed, dorsal contour angling down in front of eyes; scale-free to 1/2 way to anterior nostrils, interorbital less than twice eye diameter, almost flat; eye diameter equal to snout length. Upper lip terminal, neither thick nor high, median height c. 1/4 eye diameter; symphyseal knob comparatively wide; lip groove 1/3 length of lower lip; first pair of mandibular pores large, others obscure; rami of lower jaws broadly curving; mandibular angle acute. Teeth in 1 or 2 rows in upper lip; 1 row in lower; spatulate, curving inwards, unicuspid; pretygoids and tongue toothless; flat tongue and roof of mouth papillate. Mouth corner on vertical from posterior nostril; tip of upper jaw slightly below level of mouth corner, reaching vertical from anterior rim of eye; preorbital slender, not filling space lip to eye, upper end at level 1/2 up upper lip and above line joining midpoints of posterior and anterior nostrils. Posterior nostrils reaching above level of upper rim of eye; anterior nostril overlap-

ping lower vertical span of posterior. Gill rakers long, type 3.

Pectoral fin reaching mid-eye when laid forward, not quite to vertical from origin of first dorsal fin and c. 2/3 along pelvic fin (not quite to tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical just behind base of sp. 4 of first dorsal fin; axillary scale reaching 1/2 along pelvic spine. First dorsal fin origin nearer snout tip than to caudal base; sp. 2 longer than sp. 1; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/4 along anal fin base; anterior ray tips not reaching behind tips of posterior rays; anal fin higher than second dorsal fin; both higher than first dorsal; second dorsal and anal fins densely scaled. Caudal fin deeply forked.

**DISTRIBUTION.** W Pacific.

**REMARKS.** Other than the almost cosmopolitan *M. cephalus*, this is the only species of *Mugil* recorded from the western Pacific. Duncker & Mohr (1926) gave a brief description of specimens they identified as *M. broussonnetii*, but these were recorded as having 10 rays in the second dorsal fin and 9-10 in the anal fin; the adipose tissue was reported as only slightly developed and the anal and second dorsal fins were stated to be scaly only at the base; also the first dorsal fin origin was stated to be equidistant from snout tip and caudal base. All these characters differ from those of *M. broussonnetii*. Richardson (1846) evidently named his fish *M. macrolepidotus* unaware that the name had been used previously by Rüppell (1828).

This species differs from *M. cephalus*, the only other member of the genus to occur in the same region, in having 9 rather than 8 anal rays, having fewer lateral scale rows, a longer pectoral fin and in the more dense sculation on the second dorsal and anal fins.

#### *Mugil capurrii* (Perugia, 1892)

*Myxus capurrii* Perugia, 1892: 1007, Senegal R. *Mugil capurrii* Tortonese, 1962: 334, Senegal R., Trewavas & Ingham, 1972: 17, 19, fig. 2a, Port Etienne, Agadir, Senegal, South Angel Bank. *Myxus curvidens* Steindachner, 1882: 42, Rufisque; Fowler, 1936: 598, Ascension is. Cape Verde, Senegal, non Valenciennes. *Mugil monodi* Chabanaud, 1926: 8, Port Etienne, Agadir; Chabanaud & Monod, 1926: 258, fig. 17-19, Port Etienne, Agadir; Cadenat, 1954: 585, Mauretania, Senegal, Dakar; 1955: 59, Senegal to Liberia.

**SYNTYPES.** Genoa Museum CE.38908 and BMNH 1971.4.28.14, Senegal R. BMNH. Specimens examined.

**MATERIAL EXAMINED.** 2 syntypes of *M. capurrii*, 3 syntypes of *M. monodi* and 8 other specimens, 100-447 mm SL, from Senegal, Mauritania and Morocco, BMNH: 1927.6.8.2-3, 103 & 125 mm, syntypes of *M. monodi*, Port Etienne, coll. Monod, 1933.3.29.1-2, 180 & 188, Mauritania; 1956.11.28.2, 447 mm, South Angel bank, 360-380 m depth; 1971.4.28.12-14, 3 spec, 50-60 mm, syntypes of *M. capurrii*, Senegal R., coll. Capurro. MNHN: 1826.1-4, 4 spec, 57-390 mm, syntypes of *M. monodi*, Port Etienne, coll. Monod; 1926, 118 mm, syntypes of *M. monodi*, Agadir, Gravel.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 17, L1 44-46, tr. 14-15, ped 9, pect. sc. 12-13, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 28-29. Scales cycloid, long narrow mucous canals, not quite reaching inner edge of membranous margin to scales; no multicanalicate scales, no secondary squamation. Body slender, head pointed, scale-free to 1/2 way to anterior nostrils; interorbital broad and flat, > twice eye diameter in specimens larger than 150 mm SL; eye diameter subequal to snout. Upper lip thin and low, its median height about 1/4 eye diameter; single high symphyseal knob, projecting in front of general contour of lip, visible when mouth closed; lip almost entire; lip groove 1/3 lower lip length; pair of moderate mandibular pits, width of symphyseal knob apart, just behind symphyseal groove; others obscure. Rami of lower jaw gently curving; mandibular angle acute. Long teeth curving inwards in single row in each lip, tending to be lost with age; no teeth on pterygoids or flat tongue. Mouth corner on vertical from anterior rim of eye; tip of upper jaw reaching vertical from anterior field of iris. Preorbital slender, not filling space lip to eye; upper end at level 1/2 up upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostrils not reaching above level of upper rim of eye; anterior nostril extending only slightly into lowest part of vertical span of posterior. Gillrakers long, type 4.

Pectoral fin not reaching eye when laid forward, just reaching vertical from origin of first dorsal fin and c. 2/3 along pelvic fin (not past tip of pelvic spine) when laid back; axillary scale somewhat rounded. Pelvic fin tip reaching behind vertical from base of sp. 4 of first dorsal fin; axillary scale reaching 2/3 along pelvic spine. First dorsal fin origin nearer snout than to caudal base; sp. 1 longer than sp. 2; sp. 4 long, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/3 along membrane behind sp. 4. Second dorsal fin origin varying between verticals just behind anal fin origin and 1/4 along anal base; tips of anterior rays reaching well beyond tips of posterior rays; dorsal and anal fins about equal in height; second dorsal and anal

fins lightly scaled; caudal fin deeply forked. Intestine about 4 times SL.

**DISTRIBUTION.** Morocco, Senegal, Mauritania.

**REMARKS.** The short preorbital is distinctive, as are the relatively long head, long mouth cleft, rounded pectoral axillary scale and membranous margins to the scales which resemble the condition in *Valamugil* but are not fimbriate as in that genus. Tortonese (1963) redescribed the types of *M. capurrii* and recognised *M. monodi* as a synonym. Perugia (1892) presumably placed the species in *Myxus* on the basis of the long mouth cleft which, with other characteristics, suggest that *M. capurrii* may be the most primitive of extant species of *Mugil*.

### *Mugil cephalus* Linnaeus, 1758

*Mugil cephalus* Linnaeus, 1758, European seas, Gronov. 1763: 142, European seas; Bloch, 1783: 129, pl. 394 (Part), European seas; Gmelin, 1789: 1397, European seas; Sonnini, 1799: 296, pl. 23, fig. 2, Egypt; Bloch & Schneider, 1801: 120, European seas; Russell, 1803: 64, Vizagapatam; Shaw, 1804: 134, Mediterranean, North Sea; Delarochie, 1809: 358, pl. 21, fig. 7, Balearic Isles; Rizzo, 1826: 368, Nice; Cuvier, 1816: 292, European seas; 1829: 231, Mediterranean; Hamilton-Buchanan, 1827: 119, Ganges R.; Bonaparte, 1834: 83, pl. 91, fig. 1, Adriatic, Valenciennes, 1836: 19(14), fig. 307, Mediterranean, France, Rome, Venice; Guichenot, 1850: 67, Algeria; Kittlitz, 1858: 20, Varan, Caroline Islands; Dumeril, 1858: 263, Senegal; Günther, 1861b: 417, R. Niger, Mediterranean, Madeira, Nile R., Tunis, west Africa; Blanchard, 1866: 231, France, Steindachner, 1868: 680, Spain; 1870: 952, St. Louis, Senegal; 1895: 33, Macarada R., Liberia, Moreau, 1881: 183, France; Jordan & Swain, 1887: 263, America; Carus, 1893: 705, Mediterranean; Vinciguerra, 1893: 323, Grand Canary; Jordan & Culver, 1895: 422, Sinaloa; Jordan & Evermann, 1896: 811, Cape Cod to Brazil; Monterey to Chile; 1905: 149, fig. 48, Honolulu, Kailua; Abbott, 1899: 343, Peru; Boulenger, 1901: 351, Congo R.; 1907: 429, pl. 80, fig. 1, R. Nile; 1916: 80, fig. 47, Bah-el-Tawilah in freshwater, L. Mendeleh, Ghat el Nassara, R. Nile near Sammanud, R. Niger, Lagos, St. Louis, Senegal, Banana, Lower Congo, St. Lugo, Cape Verde Islands, Cabinda, Cape of Good Hope, Port Elizabeth, Durban, Natal; Bean, 1903: 363, New York; Toshi, 1903: 2, pl. 1, fig. 1, pl. 2, fig. 22, Moreton Bay; Fowler, 1903: 704, Syria, Peru, Uruguay, Syria, Florida, North Carolina, Woods Hole; 1920: 251, Elmina, Ashantee, 1922: 9, Molokai, Ocean Is., Honolulu; 1928a: 125, Hawaii, Guam, Marshall Islands; 1935: 141, Hong Kong, Shanghai; 1936: 584, Cabezon, Thiru, Zouli, Congo R. mouth; 1938b: 219, 252, 276, Makepan, Honolulu, Chatham Is., Hood Is.; Gilbert & Stark, 1904: 59, Panama Bay; Seale 1906: 17, Tahiti, Rapa, Solomon Islands; 1914: 61, Hong Kong, Regan, 1907a: 71, Central America; 1915: 127, Lagos; Jordan & Richardson, 1908: 244, Calayan, Babuyan, Philippines; Anipa, 1939: 71, fig. 23 a,b, Black Sea; Ninni, 1909: 313, Adriatic; Tanaka, 1911: 50, pl. 15, fig. 42-45, Japan; Jordan & Metz, 1913: 25, Korea; Pellegrin, 1913: 155, Roman, 1914: 31, Baie de Louvet, Senegal, Rufisque, Banana, Jordan & Thompson, 1914: 270, Japan; Ribeiro,

- 1915: 3, Brazil; Chaudhuri, 1917: 495, L. Chulka; Asha-nassopoulos, 1919: 265, fig. 3, Mediterranean; Oshima, 1919: 286, Taiwan; 1922: 242, Taiwan; Weber & De Beaufort, 1922: 253, Java, Borneo; Nicholls & Murphy, 1922: 506, Peru; Meek & Hildebrand, 1923: 275, Panama; Waite, 1923: 107, South Australia; Joubin & Le Danais, 1924: 43, fig., France; Lord & Scott, 1924: 48, fig., Tasmania; Roule, 1925: 52, pl. 12, fig. 22, 22a, France; Barnard, 1925: 302, Table Bay to Natal; Jordan & Hubbs, 1925: 207, Japan; Chabanud & Monod, 1927: 257, Port Etienne; Chevey, 1928: fig., Mediterranean; 1929: 245, fig., European Atlantic; 1932: 54, fig. 19, Thailand; Popov, 1929: 245, fig. 1, Vladivostok, Black Sea near Batum, Anatolia; 1930: 56, Black Sea, Mediterranean, NE Atlantic; Soldatov & Laitberg, 1930: 97, China Sea; Jacot, 1930: 828, (Japan); Ishikawa, 1931: pl. 22, fig. 1, Japan; Roxas, 1934: 406, Philippines; Borcea, 1934: 251, fig. 14, Roumanian Black Sea; Nobre, 1935: 327, fig. 144, Portugal; Smith, 1935: 600, fig. 3, pl. 15, Lakeside, Knysna, Kobeljaauws R., Port Elizabeth, Zwartkops Kosi Bay, Mazeppa Bay, Buffalo R., Sinkawazi; 1948: 835, fig. 2, Cape Town to Beira; 1949: 317, fig. 877, Kowie R., Great Fish R., Buffalo R., Mazeppa Bay, Durban, Inkawazi, Kosi Bay; Barnhart, 1936: 36, fig. 122, S California; Tarantetz, 1937: 86, China Sea; Arné, 1938: 91, figs 8, 9, Gulf of Gascony; Joubin, 1938: 341, fig., Mediterranean to Egypt; Gulf of Gascony, Canary Is, W Africa; Buen, 1942: 44, Mexico; Hildebrand, 1946: 422, Peru; Irvine, 1947: 198, Ghana; Lozano Rey, 1947: 721, pl. 19, fig. 1, Guadalquivir R. at Cordova, Laguna de la Janda, Sevilla, Guadalhorce R., R. Guadalfeo, Vinaroz; Boesman, 1947: 116, Japan; Berg, 1949: 992, rivers entering the Black Sea; Berg et al., 1949: 537, fig., Sakhalin to Australia, Loire R. to Cape Town, California to Chile, West Indies, Mediterranean; Devasundaram, 1951: 21, Chilka Lake, Orissa, 1952: 118, Japan; Alimov, 1952: 411, Amur, Graham, 1953: 13, fig., New Zealand; Thomson, 1954: 91, pl. 1, fig. 1, Tirano, Adriatic, New Caledonia, Boran Is., Kagoshima, Tanagoshima, Swan R., Greenough R., Chapman R., Tweed R., L. Mlawara, Shuk Bay, Abrolhos Is., Murchison R. to Cordunup R., Murray R. mouth, Lakes Entrance, Obizu R., Irawaka R., Knysna, Monaco; Ben-Tuvia, 1954: 16, Israel; Mann, 1954: 201, Chile; Cadenat, 1954: 586, Morocco to Angola; 1955: 60, West Africa; Nikolski, 1954: 422, cosmopolitan; 1956: 452, Amur R.; Dollfus, 1955: 139, Atlantic coast of Morocco; Dieuzeide et al., 1955: 233, fig., Bourargere (Tunisia); Matsubara, 1955: 496, Japan; John, 1955: 226, Kankulam Is.; Munro, 1955: 93, pl. 16, fig. 251, Sri Lanka; 1967: 169, pl. 18, fig. 285, New Guinea; Morovic, 1957: 9, Adriatic; Morrow, 1957: 23, Peru; Marshall et al., 1959: 93, S Queensland; Chying, 1961: 322, col. pl. 23, fig. 126, pl. 17, fig. 575, Korea; Scott, 1962: 132, fig., South Australia; Pillay, 1962: 558, pl. 1, fig. 1, Madras, Bombay, Baluchistan, Chulka L., Jaunpur (West Bengal), Narakkal, Bănărescu 1964: 610, fig., Roumania; Syetovidov, 1964: 208, figs 58-59, Iran; Ladiges & Vogt, 1965: 151, pl. 35, S Europe in fresh water; Blanc & Bănărescu, 1965: 26, S Europe in fresh water; Tortorese, 1966: 98, fig., New Guinea; 1972: 27, Genoa, Magna, Venetian Lagoon, L. Fusaro, L. Patria, Tunisia, Greece; Lerm & Scott, 1966: 334, Halifax; Wheeler, 1969: 462, Mediterranean, Black Sea, Atlantic to S Bay of Biscay; Bini, 1968: 31, fig., Italy; Cabo, 1979: 176, fig. 45, Mar Menor; Bauchot & Prist, 1980: 300, pl. 15, Tropical Atlantic to Gulf of Gascony, Mediterranean, Cadwallader & Backhouse, 1983: 129, Coastal Victoria; Gomon et al., 1994: 662, S Australia; Shen, 1994: 438, pl. 138, fig. 4, Taiwan.
- Arulon cephalus* Gistel, 1848: 109, warm temperate seas.
- Ulocephalus* Gistel, 1848: 109, warm temperate seas.
- Mugil cephalus cephalus* Cadenat, 1954: 589, Mediterranean; Trewavas & Ingham, 1972: 17, warm temperate seas; Masuda et al. 1984: 119, pl. 104, fig. G, Japan.
- Mugil albula* Linnaeus, 1766: 250, Charleston, South Carolina; Gmelin, 1789: 1398, NW Atlantic; Shaw, 1804: 137, America, Bahamas; Valenciennes, 1836: 96(71), New York, Jamaica; DeKay, 1842: 146, New York; Jordan & Gilbert, 1883a: 266, Galveston; 1883b: 403, North America; Jordan, 1885: 115, New York; Bean, 1890: 272, pl. 21, fig. 26, Great South Bay, Long Is.; Rutter, 1896: 264, California.
- Mugil aor (aor)* Forsskal, 1775: 74, Arabia; Ruppell, 1835: 131, Red Sea; Bleeker, 1860d: 52, Borneo; Klunzinger, 1870: 829, Red Sea; 1884: 132, pl. 10, fig. 16, Red Sea; Day, 1876: 353, pl. 75, fig. 3, Bombay; 1888b: 800, Bombay; 1889: 348, fig. 114, India; Rochebrune, 1882: 95, Rufisque, Gorée; Steindachner, 1882: 40, Senegambia; Steindachner & Döderlein, 1887: 266, Japan; Jordan & Evermann, 1903: 332, Taiwan; Tsch, 1903: 3, Moreton Bay; Jordan & Thompson, 1914: 270, Japan; Boulenger, 1916: 82, fig. 48, Socotra, Madagascar; Rodriguez; Oshima, 1919: 270, Japan; Wu, 1929: 78, fig. 62, Amoy; Pellegrin, 1935: 72, fig. 93, Madagascar in fresh water; Qureshi, 1955: 54, Pakistan; Pandey & Sandhu, 1992: 271, Bombay, Red Sea to China and Japan.
- Mugil prozensalis* Risso, 1810: 346, Nice.
- Mugil plumieri* Valenciennes, 1836: 90(66), Martinique, New York, St Vincent; DeKay, 1842: 147, New York; Jordan & Gilbert, 1878: 381, Beaufort Harbour, non Bloch.
- Mugil lineatus* Valenciennes, 1836: 96(71), New York; DeKay, 1842: 114, pl. 15, New York; Ayres, 1843: 265, pl. 12, Brookhaven; Günther, 1861b: 417, Atlantic coast of North America.
- Mugil constantiae* Valenciennes, 1836: 107, Cape of Good Hope; Smith, 1849: pl. 28, Cape of Good Hope; Günther, 1861b: 418, Cape of Good Hope in fresh water; Lampe, 1914: 227, Simonstown.
- Mugil constantiae* Bleeker, 1860f: 54, Cape of Good Hope.
- Mugil cephalatus* Valenciennes 1836: 110(81), Pondicherry, Langes R., Eydoux & Souleyet, 1841: 175, Hawaii; Bleeker, 1859a: 277, Indonesian Archipelago; 1860d: 51, Borneo; 1861d: 76, Penang; 1874: 45, Madagascar; Günther, 1861b: 419, fig., Red Sea, Pondicherry, Amoy, Chusan, China, Sea of Japan; Kner, 1865: 224, Java, Manila, 'New Holland', Streets, 1878: 73, Honolulu; Lockington, 1879: 305, California; Peters, 1880: 923, Ningpo; Macleay, 1880: 416, Port Jackson; 1881: 47, Port Jackson; 1882: 262, New Guinea; Sauvage, 1891: 402, pl. 498, figs 2-3, Madagascar; Whitehouse, 1927: 80, Madras.
- Mugil borbonicus* Valenciennes, 1836: 113(84), Bourbon R., Réunion, Malabar; Sauvage, 1891: 395, pl. 42, fig. 3, Madagascar.
- Mugil citulabris* Valenciennes, 1836: 151(112), Lima.
- Myxus citulabris* Günther 1861b: 467, Lima; Steindachner, 1882: 42, Galapagos; Mohr, 1927: 181, fig. 14, Galapagos, Peru.
- Quartrana citulabris* Jordan & Swain, 1884: 273, Galapagos, Peru.
- Mugil capadocii* Eydoux & Souleyet, 1841: 171, pl. 2, fig. 1, Hawaii.
- Mugil rammelsbergii* Tschudi, 1845: 20, Is. of San Lorenzo (Peru); Günther, 1861b: 420, Chile; Hildebrand, 1946: 420, Peru.
- Mugil rammelsbergii* Tortorese, 1963: 334, Peru.
- Mugil japonicus* Schlegel, 1845: 134, pl. 72, fig. 1, Nagasaki; Richardson, 1846: 247, seas of China and Japan; Bleeker, 1853b: 41, Bengal; 1879b: 17, China; Oshima, 1921: 73,

- Taiwan; 1922: 243, Taiwan; Matsubara, 1955: 496, Japan; (2) Chying, 1941: 324, pl. 117, fig. 57b, pl. 119, fig. 589, Korea.
- Mugiliza* Gay, 1847: 256, fig. 2, Chile, non Valenciennes.
- Mugil berlandieri* Girard, 1859: 20, figs 1-4, (Rio Grande); (fide Evermann & Kendall, 1894).
- Mugil dobula* Günther, 1861b: 420, fig., Perth, (Western Australia), Aeneum; 1877: 214, pl. 120, fig. A, Australian coast, Aeneum; Hawaii; Kner, 1865: 224, Hong Kong; Macleay, 1880: 414, E coast of Australia; Castelnau, 1879: 50, Norman R.; Ogilby, 1893: 118, pl. 31, New South Wales; 1897a: 74, Tasmania; Steindachner, 1901: 501, Honolulu; Stead, 1906: 75, fig. 27, Victoria to central Queensland; 1908: 40, New South Wales; McCulloch, 1914: 326, New South Wales; Fowler & Bean, 1922: 17, Philippines.
- Mugil ashtanteensis* Bleeker, 1863a: 91, pl. 19, fig. 2, Ashantee; (fide Steindachner, 1870: 953, St Louis, Senegal).
- Mugil cephalus ashtanteensis* Cadenat, 1954: 584, 591, Morocco to Angola; Poll, 1959: 258, fig. 87, West Africa; Cadenat & Roux, 1964: 87, West Africa, Trewavas & Ingham, 1972: 17, West Africa.
- Myxus superficialis* Klunzinger, 1870: 832, Red Sea; Mohr, 1927: 150, fig. 12, Kowier.
- Mugil gelatinosus* Klunzinger, 1872: 35, Murray R. (South Australia); 1880: 396, pl. 8, fig. 1.1a, Hobson's Bay; Macleay, 1885: 41, Murray R.
- Mugil tanguensis* Castelnau, 1872: 140, Victoria, non Quoy & Gaimard.
- Mugil penzance* Hector, 1872: 110, pl. 6, fig. 57, New Zealand; Fulton, 1872: 36, New Zealand, non Valenciennes.
- Mugil grandis* Castelnau, 1875: 32, New South Wales; Macleay, 1880: 412, Georges R., Elizabeth Bay, Parramatta R.; 1881: 47, Brisbane, New South Wales.
- Myxus caecutiens* Günther, 1876: 397, Rodriguez in fresh water; Sauvage, 1891: 40, pl. 42, fig. 2, Madagascar.
- Mugil mexicanus* Steindachner, 1876: 86, Acapulco; Jordan & Gilbert, 1883c: 403, Mexico.
- Mugil platanius* Günther, 1880a: 9, Rio de la Plata; Jordan & Swain, 1884: 266, Argentina; Ribiero, 1915: 5, Brazil.
- Mugil tongae* Günther, 1877: 217, Tongatabu; 1880b: 58, Tongatabu; 1881: 217, Tongatabu; Fowler, 1928a: 126, quotes.
- Mugil mulleri* Klunzinger, 1880: 395, King George Sound; Macleay, 1885: 42, King George Sound.
- Mugil curtus* Lortet, 1881: 131, pl. 11, fig. 2, Lake Tiberias (part), non Yarrell.
- Mugil ochroleucus* Lortet, 1883: 132, pl. 11, fig. 1, Lake Tiberias (part), non Günther.
- Mugil auratus* Lortet, 1883: 143, pl. 11, fig. 3, Syria, non Risso.
- Mugil marginatus* De Vis, 1884: 870, Brisbane; Saville-Kent, 1889: 10, Great Barrier Reef (mis-spelt *marginatus*).
- Mugil hypoclinus* Ogilby, 1897b: 74, Port Jackson, Botany Bay, Tasmania.
- Myxus barnardi* Gilchrist & Thompson, 1914: 83, Durban Bay; 1916: 273, Durban Bay; Barnard, 1925: 311, Durban Bay.
- Myxus flavus* Mohr, 1927: 182, fig. 4, Mizatlan, Huile Popo.
- Myxus lepidopterus* Mohr, 1927: 181, fig. 3, Peru.
- Myxus niger* Mohr, 1927: 183, fig. 5, Luna.
- Myxus unicolor* Mohr, 1927: 186, fig. 6, Cape Huiteras.
- Agonostoma monticola* Pearson, 1937: 97, Gadjamarea (Peru), (fide Follett [1960]), non Bancroft.
- Mugil peruanus* Hildebrand, 1946: 424, fig. 2, Peru.
- Mugil catalanensis* Whitley, 1951: 394, New Guinea.
- Mugil galapagensis* Ebeling, 1961: 295, Galapagos.
- MATERIAL EXAMINED 252 specimens, 18-524mm SL (including the types of *M. barbonicus*, *M. ashtanteensis*, *M. catalanensis*, *M. cephalus*, *M. dobula*, *M. constantiae*, *M. dobula*, *M. flavus*, *M. galapagensis*, *M. lepidopterus*, *M. lineatus*, *M. niger*, *M. platanius*, *M. runcoides* and *M. tongae*) from all seas. BMNH: 1844.2.15.51, skin, syntype of *M. dobula*, Perth Water, Swan R., coll. Gould, 1847.6.17.23, skin, syntype of *M. dobula*, Perth, coll. Macgillivray; 1848.10.25.32, 255mm, syntype of *M. dobula*, Perth, coll. Warwick; 1851.2.29.7-8, 118 & 184mm, syntypes of *M. dobula*, Australia, coll. Macgillivray; 1869.7.18.3, syntypes of *M. dobula*, Australia, coll. Macgillivray; 1869.7.18.3, 142mm, syntype of *M. dobula*, Aeneum, coll. Macgillivray; 1848.10.25.39, skin, Australia; 1850.12.1.16, 102mm, North America; 1852.8.17.37, 60mm, R. Nile; 1862.12.19.26, 270mm, Port Natal; 1864.4.25.109-114, 4 spec. 325-344mm, Golden Horn; 1864.7.6.22, 242mm, Hawksbury R.; 1864.7.13.69, 8 spec. 67-88mm, Caber Negor, Brazil; 1864.10.9.4, 153mm, Hawksbury R.; 1867.12.30.32, 84mm, Narenta, Jugoslavia; 1868.6.22.4, 152mm, Valparaiso; 1871.8.18.6, 214mm, Hobart; 1872.4.26.7, 149mm, Wellington; 1872.9.9.2, 3 spec. 470-524mm, Galapagos; 1876.3.11.31-32, 90 & 95mm, syntypes of *M. ashtanteensis*, Rodriguez, coll. Gulliver; 1877.12.16.37, 272mm, Tonga; 1878.10.14.4, 220-311mm, syntypes of *M. platanius*, La Plata, coll. Whitt; 1879.4.14.497, 130mm, holotype of *M. tongae*, Tongatabu, coll. 'Challenger Exp'; 1879.5.14.495 & 498, 116 & 247mm, Mary R. Queensland; 1879.5.14.496, 210mm, Hilo; 1879.5.14.500-1, 87 & 93mm, Mary R.; 1880.9.14.46, 148mm, Woods Hole; 1881.3.14.65, 268mm, San Diego; 1881.3.30.4.8, 3 spec. 108-120, Socotra; 1883.11.29.59-60, 216 & 285mm, New South Wales; 1883.12.15.61-3, 3 spec. 111-320mm, Honolulu; 1884.8.26.50, 243mm, Istanbul; 1885.1.14.26, 160mm, Galapagos; 1885.1.14.27-28, 98 & 195mm, Peru; 1885.2.3.42-8, 7 spec. 18-53mm, Rio Grande de Sol, Brazil; 1886.1.21, 53-62, 10 spec. 51-75mm, Rio Grande de Sol; 1886.5.22.5-6, 317 & 320mm, Perth; 1886.11.18.50, 375mm, Auckland; 1887.3.29.30, 139mm, Penzance, Guardiana, Portugal; 1887.5.14.159, Penzance; 1887.12.22.52, 292mm, Famiave, Madagascar; 1889.2.1.37-14.7, 4 spec. 35-97mm, Madras; 1889.2.1.37-18-9, 150 & 198mm, Bombay; 1889.2.1.37-20, 152mm, Sind; 1889.8.15.11, 263mm, Silvas, Portugal; 1890.9.23.99, 340mm, Port Jackson; 1891.5.19.144, 360mm, California; 1891.5.19.145, 78mm, San Diego; 1892.6.29.10, 98mm, Rio de Janeiro; 1895.5.31.12, 400mm, Shanghai; 1896.5.17.55, 330mm, Melbourne markets; 1897.10.26.70, 138mm, Omble R., near Gravano, Yugoslavia; 1897.10.27.30, 115mm, Botany Bay; 1901.6.28.169, 200mm, Narborough Is.; 1905.6.8.25-6, 68 & 77mm, Durban Bay; 1907.12.2.280-6, 7 spec. 52-59mm, Ghat-el-Nassera (Lake Menzaleh); 1907.12.2.280-11, 4 spec. 52-63mm, Ghat-el-Nassera; 1907.12.2.281-4, 3 spec. 54-57mm, Ghat-el-Nassera in freshwater pool; 1907.1.2.2815, 385mm, Gemil, L. Menzaleh; 1907.1.2.2816 & 2846, 107 & 122mm, Bah-el-Jawid, freshwater; 1907.1.2.2817-20, 4 spec. 135-280mm, R. Nile, W of Samannud; 1909.9.3.16-20, 5 spec. 236-310mm, Port Elizabeth; 1913.7.10.41-4, 4 spec. 89-142mm, Pacomayo, Peru; 1914.8.20.253-7, 5 spec. 73-150mm, New South Wales; 1916.1.18.1.368mm, Knyazna; 1916.9.23.34-8, 5 spec. 18-34mm, Durban; 1920.12.23.18-19, 125 & 192mm, Akkoloni, Israel; 1923.2.22.28-9, 60 & 62mm, Wadi Solman, Haifa; 1923.7.30.289, 257mm, Rio de Janeiro; 1923.7.30.292, 122mm, Rio de Janeiro; 1925.9.19.91, 72mm, Ismailia Lagoon; 1925.12.31.47, 85mm, L. Tinnah, Egypt; 1925.14.11.8, 277mm, Australia; 1927.10.28.23-4, 85 & 90mm, NW Australia; 1928.1.21.55-7, 3 spec. 150-220mm, 'Thrace'; 1934.2.22.54, 195 & 247mm, Mauritius; 1938.11.1.63, Haifa; 1943.8.6.868-93, 6 spec. 59-154mm, Aransas; 1948.8.6.874-88, 15 spec. 48-84mm, Texas; 1948.8.6.889-901, 3 spec. 52-57mm, Texas; 1949.9.16.457-474, 17 spec. 62-122mm, R. Naamer, Israel; 1949.5.18.5-8, 4 spec. 42-48mm, paratypes of *M. peruanus*, La Lagunilla, Peru coll. Hildebrand; 1949.5.18.1-4, 4 spec. 53-91mm, La Lagunilla;

TYPE. None. Type locality. European seas.



1957.4.24.64-5, 70 & 75mm, Suk, Socotra; 1957.4.24.95-100, 5 spec. 73-94, Socotra; 1960.3.15.1703, 132mm, Suakin, Sudanese Red Sea; 1963.5.14.483-7, 5 spec. 160-175mm, Banyuls; 1968.12.13.462-4, 3 spec. 103-120mm, Khebir R., near Lattakia; 1969.1.7.25-8, 3 spec. 78-186mm, Naples. MNHN: 4183, 145mm, Sydney; 5845, 3 spec. 85-106mm, syntypes of *M. lineatus*, New York, coll. Gilbert; 6448, 137mm, locality unknown; 8102, 179mm, syntypes of *M. cephalotus*, Malabar coast, coll. Dussumier; A.1213, 221 & 260mm, Sydney; A.3213, 271mm, San Diego; A.3592, 90mm, Toulon; A. 3627, 7 spec. 42-71mm, syntypes of *M. ciliilabris*, Lima, coll. Goudichaud; A. 3628, 6 spec. 41-76mm, syntypes of *M. ciliilabris*, Lima, coll. Goudichaud; A.3660, 160mm, holotype of *M. borbonicus*, Réunion, coll. Dussumier; A.3663, 345mm, syntypes of *M. constantiae*, Cape of Good Hope, coll. Quoy & Gaimard; A.3690. 191 & 193mm, Martinique; A.4645, 270mm, syntype of *M. cephalotus*, Pondicherry, coll. Leschenault; A.4698, 280mm, syntype of *M. cephalotus*, Pondicherry, coll. Leschenault; A.4847, 284mm, Martinique; A.4848, 302 & 333mm, Chile. AM: IB.2242, 148mm, holotype of *M. catalanum*, R. Bogny, New Caledonia, coll. Whitley; IB.2836, 210mm, Anse Vata, New Caledonia. BPBM: 6315, 186mm, Honolulu fish market. LA: 155, 7 spec. 120-150mm, Palamas, Greece. QM: I.121, 173mm, holotype of *M. marginalis*, Brisbane, coll. De Vis; I.9774, 79mm, paratype of *M. marginalis*, Brisbane, coll. De Vis. RMNH: 1166, 380mm, lectotype of *M. japonicus*, Japan, coll. Schlegel; 1161-6, 5 spec. 131-375mm, paralectotypes of *M. japonicus*, Japan, coll. Schlegel; 1631, 202mm, holotype of *M. ashantheensis*, Ashantee, Ghana, coll. unknown. ZIZM: H.58, 112mm, paralectotype of *M. flavus*, Mazarlan, coll. Meyer; H.72, 29mm, lectotype of *M. tincoides*, Cape Hatteras, coll. 'Hamburg Exp'; H.127, 310mm, holotype of *M. lepidopterus*, Peru; H.172, paralectotypes of *M. tincoides*, Cape Hatteras, coll. 'Hamburg Exp'; H.193, 102mm, paralectotype of *M. niger*, Lima, coll. Boch.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 8, P (16) 17, L1 37-43; tr. 14-15, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 13, D<sub>2</sub> sc. 25. Scales pavement ctenoid, mucus canals straight, marked secondary squamation, no multicanalicate scales. Body robust, profile rounded, head scale-free to slightly in front of anterior nostrils; interorbital almost flat, less than twice eye diameter in small fish, but twice eye diameter in fish longer than 300mm SL; eye diameter longer than snout. Upper lip thin, low, median height < 1/4 eye diameter; lip groove 1/3 lower lip length; anterior mandibular pores large, immediately behind symphysial groove; 3 ob-points of posterior and anterior nostrils; posterior nostrils extending above level of upper rim of eye; anterior nostril entirely below vertical span of posterior. Gill rakers long, type 5.

Pectoral fin reaching posterior rim of eye or slightly behind when laid forward, not nearly to vertical from origin of first dorsal fin but 1/2 along pelvic fin (not reaching tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale reaching 2/3 along pelvic spine. First dorsal fin origin nearer snout tip than to caudal base; sp. 1 longer than sp. 2; sp. 4 slender, just reaching vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/4 along membrane behind sp. 4.

Second dorsal fin origin at vertical 1/4-1/2 along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal fin higher than subequal dorsal fins; second dorsal and anal fins scaled anteriorly and along base. Caudal fin deeply forked.

**DISTRIBUTION.** Warm temperate to tropical seas.

**REMARKS.** Bicuspid inner teeth and high longitudinal scale count distinguish *M. cephalus* from other species of *Mugil* with 8 anal rays, except for *M. liza* which has only 1 or 2 rows of bicuspid teeth in the upper lip and none in the lower, as well as having a lower scale count.

There has been general recognition that Linnaeus' *M. cephalus* is a composite of at least 3 species of European mullet. No specimens of *M. cephalus* have survived in Linnaeus' collection (Lonnberg, 1896; Holm, 1957). Probably the *M. cephalus* of other early workers was also a composite. This seems certainly the case with Bloch (1788); later inspection of his collection (Troschel, 1840) failed to reveal any specimen of *M. cephalus*.

Of the 8 surviving specimens, 1 is a *Liza aurata* (the specimen figured by Bloch), 1 is a *Liza saliens*, and 6 are *Liza ramada* (E. Trewavas, pers. comm.). The species as distinguished by Risso (1926), Cuvier (1829) and Valenciennes (1836) is now clearly established. Trewavas & Ingham (1972) indicated the advantages of accepting these authors' views and ignoring the description of *M. cephalus* in Risso (1810).

*Mugil lineatus*, *M. constantiae* and *M. cephalotus* have long been accepted as synonyms of *M. cephalus*. Examination of the types has produced no reason to disagree. Valenciennes (1836) recorded A III 9 for *Mugil ciliilabris* but all 13 syntypes have A III 8. Eydoux & Souleyet also gave A III 9 for their *Mugil chaptalii* but the holotype and paratype have A III 8 and are typical young *M. cephalus* in which the teeth stand well out of the lip. The original remark about the teeth has led to mistaken identification of *Chaenomugil leuciscus* as *Neomyxus chaptalii*. The remaining types listed at the commencement of the description have all been examined and all show features identical with those of *M. cephalus*. The majority are small, including the several types of Mohr (1927) who was apparently misled by the changing proportions of the head parts as the mullet passed from querimana stage to juvenile stage. Lortet's specimens have been examined by Trewavas (personal communication). Of the 2 specimens labelled *M. octoradiatus*, 1 is a *Mugil*

*cephalus*, the other a *Liza ramada*. 5 specimens of Lortet's *M. curtus* were *M. cephalus* (Lyon 2916 and 2917), but 1 (2915) was in too poor a condition to be identified. 2 specimens labelled *M. auratus* (Lyon 2920 and 2925) were typical *M. cephalus*. Ebeling (1961) distinguished *M. galapagensis* as having only bicuspid teeth. This is true of the paratype made available (USNM 26683), but a number of specimens from the Galapagos Islands in the British Museum have incomplete rows of unicuspid teeth outside the bicuspid rows. No other differences could be detected in either the paratype or the British Museum specimens when they were compared with typical *M. cephalus* from elsewhere. It is probable that feeding in the harsh rocky environment of the Galapagos, so different from the muddy substrate of the estuaries usually favoured by *M. cephalus* results in early wear and loss of teeth. In common with investigators such as Schultz (1949) and Sylva, Stearns & Tabb (1956) I have had doubts about the common identity of all the widespread populations attributed to *M. cephalus*. Certainly at the genetic level differences have been established (Hongskul 1968, Peterson & Shehadeh, 1971) and Cadenat (1954) and Delais 1961 with Trewavas & Ingham (1972) have noted anatomical features which they believe differentiate W African from European specimens. Most, if not all, W African specimens display the traits they list, but I have found these same traits in a proportion, usually small, of fish from all populations where a reasonable number of specimens has been available. I am not convinced that *M. japonicus* Chying (1961) is this species. He distinguished it from *M. cephalus* but his description is inadequate; the figure shows an unusually high upper lip, and in general form looks like *Crenimugil crenilabris*, but this species has not been recorded north of Taiwan.

### *Mugil curema* Valenciennes, 1836

*Mugil curema* Valenciennes, 1836: 87(64), Bahia, Martinique, Cuba; Gay, 1847: 250, Chile; Jordan & Swain, 1884: 268, Cape Cod to Brazil, Magdalena Bay to Chile; Bean 1888: 145, Great Egg Harbour, New Jersey; Jordan & Culver, 1895: 422, Sinaloa; Jordan & Evermann, 1896: 818, Cape Cod to Brazil, Magdalena Bay to Chile, Baja California, central America; Rutter, 1896: 264, Baja California; Jordan & Rutter, 1898: 98, Kingston; Evermann & Marsh, 1902: 113, fig. 24, Puerto Rico; Fowler, 1903: 744, Woods Hole, New Jersey, North Carolina, Florida, San Domingo; 1912a: 144, St Croix Is., Florida; 1919b: 278, Loanda, Angola; 1936: 596, fig. 271, Angola; Gilbert & Stark, 1904: 60, Panama Bay; Regan, 1907a: 71, Central America; Ribiero, 1915: 6, Brazil; Meek & Hildebrand, 1923: 279, Panama, Atlantic & Pacific coasts; Hildebrand & L. 1936: 126, Peru; Schultz 1949: 111, Venezuela,

Leeward Is., E. Colombia; Mann, 1954: 50, Chile, Cadenat, 1954: 589, Senegambia; Morrow, 1957: 26, Peru; Prill, 1959: 260, fig. 88, Senegambia; Boeseman, 1963: 13, R. Niger, Cadenat & Roux, 1964: 87, Senegambia; Guirard, 1979: 263, fig. 239, Cuba.  
*Mugil petrus* Valenciennes, 1836: 89(65), Brazil, Surinam, Gulf of Mexico (part); DeKay, 1842: 147, New York.  
*Mugil brasiliensis* Günther, 1861b: 431, Playa Vicente (Vera Cruz), San Domingo, Jamaica, St Vincent, British Guiana, Surinam, Canipe, Peru, 1869: 443, Belize, Panama; Trochiel, 1866: 221, Cape Verde Islands; Cope, 1871: 481, St Croix; Pacy, 1875: 99, Cuba; 1876: 61, pl. 7, figs 4-8, Cuba; Steindachner, 1876: 88, Rio de Janeiro, Canavieiras, Campeche, Mendez, Santa Cruz, Panama; 1879: 60, Rio de Janeiro, Canavieiras, Campos, Mendez, Pernambuco, Santa Cruz, Panama, Acapulco, Jordan & Gilbert, 1878: 381, Beaufort; 1881: 232, Baja California, Mexico, San Salvador, Guyana; 1883c: 602, Charleston, South Carolina; 1883d: 402, Cape Cod to South America; Jordan, 1881: 20, Florida, E coast; 1885: 115, Key West; 1887b: 530, description of syntypes, Osorno, 1894: 134, St Thomas; Metzelan, 1918: 237, Caracas, (?) non Agassiz & Spix.  
*Myxus harenensis* Günther, 1861b: 467, Central America, Pacific coast; Mohr, 1927: 194, Quoting.  
*Querquas harenensis* Jordan & Gilbert, 1883c: 588, Charleston; Jordan & Swain, 1884: 274, Mazatlan, Panama, Peru; Jordan & Culver, 1895: 474, Sinaloa; Jordan & Evermann, 1896: 817, Mazatlan to Peru; Gilbert & Stark, 1904: 60, Panama Bay.  
*Mugil guentheri* Gill, 1863: 243, Cuba; 1864: 169, central America, West, non Steindachner.  
*Mugil lineatus* Storer, 1867: 167, pl. 16, fig. 4, Massachusetts, non Valenciennes.  
*Mugil charlottae* Steindachner, 1907: 129, pl. 4, fig. 2, La, Guayaquil.  
*Mugil cephalus* Fowler, 1903: 743, Florida, Fort Macan, South Carolina, Woods Hole, Montevideo, Peru, Beaufort, non Linnaeus (Fowler 1919).  
*Mugil metzelianus* Chabanaud, 1926: 12, Senegal; Chabanaud & Monod, 1926: 258, Port Etienne; Cadenat, 1954: 585, Senegal, Liberia; 1955: 59, Senegal, Liberia.  
*Myxus splendens* Monr, 1927: 188, fig. 10, Sinaloa.  
*Myxus calanxet* De Beaufort, 1940: 112, pl. 10a, Columbia, (Schultz 1949).

TYPE. 4 Syntypes, from Cuba, Maracaibo and Marinique, MNHN A.3653, A.4641, A.4655, A.4671. Examined.

MATERIAL EXAMINED. 4 syntypes and 77 specimens, 35-340mm SL from the West Indies, Pacific and Atlantic coasts of America and W coast of Africa. BMNH: 1850.6.7.15, 233mm, San Domingo; 1855.8.16.65-6, 93 & 95mm, St Vincent; 1855.9.19.119-120, 3 spec. 127-210mm, locality unknown; 1860.6.17.28-30, 3 spec. 129-137mm, Vera Cruz; 1861.8.13.15 16, 28 & 30mm, syntypes of *M. harenensis*, E coast North America, coll. Dow; 1862.11.23.16-17, 188 & 193mm, Bahia; 1863.8.7.145, 122mm, St Croix; 1863.12.16.38-9, 4 spec. 46-225, Pacific coast, Central America; 1864.1.26.276-7, 152 & 204mm, Chiapas; 1864.1.26.300, 263mm, Belize; 1864.1.26.409, 78mm, Panama, Pacific coast; 1866.6.7.3-4, 149 & 154mm, Barbados; 1866.11.10.21-2, 48 & 50mm, Cape Verde; 1872.7.13.8, 3 spec. 20-86mm, Barbados; 1881.10.1.27, 225mm, Mazatlan; 1883.7.29.45-7, 3 spec. 186-208mm, Presidio; 1885.1.14.29, 154mm, Brazil; 1885.1.14.30, 265mm, Baja California; 1890.11.25.39-40, 5 spec. 30-33mm, Cumberland R., St Vincent; 1891.5.1.33-42, 9 spec. 73-123mm, St Vincent; 1892.1.7.15mm, St Vincent, Cape Verde Islands; 1892.9.5.130, 230mm, Les Petres, Mexico; 1895.5.27.166-175, 10 spec. 48-83mm, Mazatlan; 1895.5.27.176-7, 173 & 178mm, Mazatlan; 1896.2.10.44,

TABLE 7. Biometrics of *Mugil* spp (2). \* continuous series along a curving edge. Abbreviations as in Tables 2-4.

Species	<i>M. curema</i>	<i>M. curema</i>	<i>M. curema</i>	<i>M. incilis</i>
Scale radii	10-11	8-9	1-14	6-10
D <sub>1</sub> (SL)	24.1-25.1	23.0-25.7	25.8-30.0	35.5-26.6
H <sub>1</sub> (SL)	27.0-27.6	27.8-28.5	27.0-27.5	24.8-26.0
HWC (HL)	30.0-32.0	33.0-34.0	33.0-34.2	30.0-32.0
IO (HL)	43.0-51.0	46.8-50.1	47.5-49.1	45.0-48.5
ED (HL)	27.0-28.6	27.0-28.5	26.5-28.4	27.0-28.7
ULH (HL)	27.8-30.0	27.2-29.4	27.8-30.0	27.8-30.0
MWML	1.4-2.4	1.5-2.4	1.5-1.7	1.4-1.6
PL (HL)	77.1-83.5	75.8-77.0	87.8-88.4	77.0-81.0
PR (PL)	27.0-28.6	24.0-27.7	27.0-28.3	28.0-29.0
PAX (PL)	30.0-37.0	30.0-37.0	43.0-46.0	40.0-41.2
VI (PL)	81.0-87.0	75.8-77.0	66.0-67.0	75.0-84.0
VAX (VL)	27.0-28.6	27.0-28.5	26.5-28.4	27.0-28.7
Pd (D)	44.0-45.5	44.0-45.5	44.0-44.8	44.0-45.5
TF (HL)	2	1	1	1
TR (HL)	2	1	1	1
LES	4	5	35-40*	6-9
FES	2	3	35-40*	3-8
Sp 2/Sp 1	3	2-3	3.0	3.0
Sp 3/Sp 2	1	1	1.4-1.5	1.4-1.5
GL	21.2	21.2	21.2	21.2
PL	38.7	40.4	44.75	40.5

104mm, Concepcion Bay, Baja California; 1897.7.1.13, 48mm, Jamaica; 1898.17.31.24, 248mm, St Helens Bay, Ecuador; 1899.1.8.4-6, 3 spec. 228-304mm, Bermuda; 1900.6.28.241-3, 3 spec. 78-140mm, St Louis, Senegal; 1902.5.27.56, 150mm, La Toia, Ecuador; 1903.5.15.276-7, 234 & 243mm, Panama; 1903.55.280-9, 9 spec. 33-41mm, Panama; 1903.3.15.23, 170mm, Gulf of Carioca; 1905.12.7.81, 80mm, Vera Cruz, Brazil; 1913.7.10.51-60, 10 spec. 40-58mm, Pacasmayo, Peru; 1920.12.22.156-7, 187 & 230mm, Tobago; 1923.7.30.291, 182mm, Sacco, San Francisco, Rio de Janeiro; 1925.11.10.12-13, 186 & 192mm, Jamaica; 1931.12.5.239, 140mm, St Johns, Antigua; 1931.12.5.251 94mm, English Harbour, Antigua; 1931.12.5.389-393, 4 spec. 54-58mm, Buccoo R., Tobago; 1933.8.8.89-91, 3 spec. 28-37mm, Santos, Brazil; 1938.6.20.11, 180mm, San Do-11, 4 spec. 189-222mm, Lagos; 1949.12.6.50-1, 154 & 207mm, Gambia; 1949.12.6.56-64, 9 spec. 88-107mm, Ohikan, Lagos; 1949.12.6.65-7, 15 spec. 62-93mm, Ohikan, 1956.9.6.34, 45mm, Tarkwe, Lagos; 1959.3.17.163, 122mm, Demerara R., Guiana; 1961.9.4.63-5, 3 spec. 128-162mm, Overwegt Ponds, Guiana; 1967.6.16.279, 232mm, Port Antonia, Jamaica. MNHN: A.3653, 103mm, syntype of *M. curema*, San Lago, Cuba; coll. Choris: A.4641, 200mm, syntype of *M. curema*, Maracabo, coll. Plée: A.4655, 340mm, Syntype of *M. curema*, Martinique, coll. Plée: A.4671, 245mm, syntype of *M. curema*, Martinique, coll. Plée: A.3613, 10mm, syntype of *M. petrosus*, Cuba, coll. Desmaret, ZIZM: F.73, 52mm, lectotype of *Axiopus splendens*, Sinaloa, coll. Mohr: H 171, 33mm, Sinaloa.

DESCRIPTION. D1 IV, D2 I 8, A III 9, P 17, L1 35-40, tr 11, ped 7, pect sc. 9-10; D1 sc. 11, D2 sc. 21-22. Scales pavement ctenoid, 10-11 radii reducing to about 7 on the scale margins of large fish; mucus canals long, narrow; some scales with double canals, some secondary squamation dorsally. Body moderately robust; head pointed, scale-free to anterior nostril; interorbital less than twice eye diameter, almost flat; eye diameter longer than snout. Upper lip terminal, moderately thick, lip groove 1/3 lower lip length; anterior mandibular pores large, breadth of symphyseal knob apart, at rear of symphyseal groove; other pores obscure. Rami of lower jaw broadly curving; mandibular angle acute in young, widening to obtuse angle with age. Teeth unicuspid, outer row long, curved, well spaced; 1 or 2 inner rows of much finer teeth; none on pterygoids or domed, low-ridged tongue. Mouth corner on vertical from posterior nostril, or slightly behind; tip of upper jaw reaching vertical midway between posterior nostrils and anterior rim of eye. Preorbital only 1/2 filling space lip to eye; upper end reaching half up upper lip, on line joining mid-points of posterior and anterior nostrils; posterior nostrils not reaching above level of upper rim of eye; anterior nostril entirely below vertical span of posterior. Gill rakers long, type 5.

Pectoral fin reaching mid-eye when laid forward, not nearly to the vertical from the origin of the first dorsal fin, 1/2 along pelvic fin (not to tip of pelvic spine) when laid back. Pelvic fin tip reaching slightly behind vertical from base of sp. 3 of first dorsal fin; axillary scale reaching c.2/3 along pelvic spine. First dorsal fin origin equidistant from snout tip and caudal base; sp. 1 longer than sp. 2; sp. 4 short, not reaching vertical from tip of sp. 3 when fin raised; axillary scale long, reaching c.3/4 length of membrane behind sp. 4. Second dorsal fin origin at vertical between 1/4 and 1/3 along base of anal fin; tips of anterior rays not reaching behind tips of posterior; anal fin higher than subequal dorsal fins; second dorsal and anal fins lightly scaled. Caudal fin forked.

DISTRIBUTION. Pacific coast of America from Gulf of California to N Chile, Atlantic coast of America from Cape Cod to Buenos Aires, and W coast of Africa from Gambia to the Congo.

REMARKS. *M. curema* has a lower (7) peduncle scale count than other *Mugil* with 9 anal rays. Its transverse scale count (11) is lower than all except *M. broussonnetii* which does not occur in same geographic range. Valenciennes (1836) stated that his *M. curema* is the same species as

Desmaret named *M. gaimardianus*. The only publication of *M. gaimardianus* was a figure in the Dictionnaire Classique d'Histoire Naturelle, edited by Audouin, St Vincent and others. There was no accompanying description but a legend declared the figure to be published at the request of M. Desmaret who had not supplied a description, the publication of his Decades Ichthyologiques having been interrupted. Apparently the decade to include *M. gaimardianus* never appeared. One of Valenciennes' syntypes came from Cuba, the locality for *M. gaimardianus*, but Valenciennes did not indicate that this was Desmaret's specimen nor does the extant label make any such indication; nor do Valenciennes' words specifically state that he had seen Desmaret's specimen. The published figure of *M. gaimardianus* includes features not known in any mullet. It is shown with V. 16 and the anal fin has 10 rays. The only mullet in the Cuban area with 10 anal rays is *Agonostomus monticola*. If the figure is in error in these details, then other details, such as the scale count of 38 may also be misleading. Even if correct this scale count is typical not only of *M. curema* but also of *M. hospes* and *M. setosus*, amongst those occurring in the Caribbean region. It seems wisest to accept the verdict of Alvarez-Lajonchère (1975) that *M. gaimardianus* be regarded as a nomen dubium. Jordan & Swain (1884) and Jordan & Evermann (1896) recognised *M. gaimardianus* however their descriptions do not differentiate their specimens from other species occurring in the same area. Poey (1875, 1876) in recognising this species described it as having the pectoral fin reaching the vertical from the first dorsal fin origin, a condition found only in *Mugil hospes* amongst Caribbean mullet. Valenciennes (1836) also stated that his *M. curema* was probably the same as *M. brasiliensis* Spix (often attributed to Agassiz & Spix or Spix & Agassiz 1831; but see Whitehead & Myers 1971). The description of *M. brasiliensis* is inadequate to distinguish it from other species of *Mugil* and the published figure, like that for *M. gaimardianus*, displays features unknown in any mullet, such as the number of pelvic fin rays. Unhappily the types were destroyed during World War II (Trewavas, 1950). At various times 3 other species of mugilid have been identified as *M. brasiliensis*. Jordan & Gilbert (1878; 1881) used the name for the species recognised here as *M. curema*. After some correspondence with Spangenberg, who was curator at Munich where Agassiz's specimen's were housed, Jordan & Swain (1884) decided that the species usually designated as *Mugil trichodon* was the rightful

*M. brasiliensis*. But later Jordan (1887b) declared this to be an unsound conclusion and referred the name to the species usually recognised as *M. liza*. In the main, subsequent authors have followed Jordan. The last recorded inspection of the types of *M. brasiliensis* was by Spangenberg, quoted ex litteris by Jordan & Swain (1884). He found the lectotype to be so badly dried out that he was unable to count the fin rays. He judged the 2 paratypes to be different species, neither identical with the lectotype. On the basis of descriptions supplied to him by Jordan & Swain he attributed them to *M. trichodon* and *M. gaimardianus*. He estimated that the poorly preserved lectotype had 32 lateral line scales which induced Jordan & Swain to accept it as being *M. trichodon*, but on this count it could equally well have been *M. liza*. Jordan's (1887b) reason for altering the designation to *M. liza* was that the published figure of *M. brasiliensis* showed 35 lateral scales. As the figure is inaccurate in other respects (e.g., fin ray numbers) it cannot be assumed that the correct number of scales are shown. Since the details of the figure are inaccurate in displaying features not known in any mugilid, as the description was inadequate for certain recognition, and as the type specimens have been irretrievably lost, it seems inevitable that acceptance be given to Trewavas' (1950) suggestion that the name *Mugil brasiliensis* be suppressed. Given the doubts about the possible validity of Valenciennes' name, Harrison (1993) has designated a lectotype. Personally I consider this unnecessary as there are 4 syntypes of *M. curema* and I believe that *M. gaimardianus* and *M. brasiliensis* are names that should be suppressed. *Myxus harenus* of Günther (*Querimana harenus* of other authors) is the immature stage of *M. curema* with only 2 anal spines. From its description *M. charlottae* Steindachner seems to be *M. curema*.

### **Mugil curvidens Valenciennes, 1836**

*Mugil curvidens* Valenciennes, 1836: 149(111), pl. 314, Ascension, Bahia.

*Myxus curvidens* Günther, 1861b: 467, quotes; Steindachner, 1882: 42, Rufisque; Fowler, 1936: 598 (part), Ascension Is.

*Querimana curvidens* Ribiero, 1915: 8, Brazil.

SYNTYPES. MNHN: A.3626, Bahia, coll. unknown; A.3646, Ascension Is., coll. Quoy & Gaimard. Examined.

MATERIAL EXAMINED. 8 syntypes and 12 other specimens 32-94mm, SL BMNH: 1861.11.7.3, 73mm, West Indies; 1822.1.10.3, 94mm, Ascension Is.; 1908.7.24.12-13, 88 & 99mm, Ascension Is.; 1932.2.19.52-7, 6 spec. 65-85mm, Ascension Is.; 1935.5.2.31-2, 32 & 81mm, Ascension Is. MNHN: A.3626, 5 spec. 62-72mm, syntypes of *M. curvidens*, Bahia, coll. unknown;

A.3646, 3 spec. 54-60mm, syntypes of *M. curvidens*. Ascension Is., coll. Quoy & Gaimard

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III (7) 8, P 15, L<sub>1</sub> 36-38, tr. 11, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 25. Scales pavement ctenoid, moderately long mucus canals, some dorsal scales with double canals. Body moderately robust, head bluntly pointed, scale-free to 1/4 distance from snout tip to anterior nostril; upper profile curving down slightly in front of eye; interorbital almost flat, about 1.5 times eye diameter; eye diameter longer than snout. Upper lip height  $\sim$  1/3 eye diameter; lower lip curled down in some specimens; lip groove 1/4-1/3 lower lip length. Anterior mandibular pores at rear of symphyseal groove, about breadth of symphyseal knob apart; other pores obscure. Rami of lower jaw widely curving; mandibular angle acute. Teeth close set in both lips, a scattered inner row at base of upper lip; unicuspid, widening slightly in their distal third; none on pterygoids or flat tongue. Mouth membrane with flat papillae. Mouth corner at vertical from posterior nostril; tip of upper jaw on line of gape, reaching vertical from anterior rim of eye. Preorbital narrow, filling only 1/2 space lip to eye; front edge not notched, upper end reaching 1/2 upper lip, above line joining midpoints of posterior and anterior nostrils. Posterior nostrils not reaching above level of upper rim of eye; anterior nostrils entirely below vertical span of posterior nostrils; nostrils equidistant from eye, lip and each other in smaller specimens, in large fish anterior nostril nearer snout than to posterior nostril, but posterior nearer anterior nostril than to eye. Gill-rakers, short, type 4.

Pectoral fin reaching anterior 1/2 of eye when laid forward, not nearly to the vertical from the first dorsal fin origin and  $\sim$  1/2 along pelvic fin (not to tip of pelvic spine) when laid back; axillary scale small and rounded. Pelvic fin tip reaching vertical midway between bases of sp. 3 and sp. 4 of first dorsal fin; axillary scale reaching 2/3 along pelvic spine. First dorsal fin origin nearer snout tip than to caudal base; sp. 2 equal to sp. 1; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c. 3/4 along membrane behind sp. 4. Second dorsal fin origin only slightly behind vertical from anal fin origin; tips of anterior rays not reaching behind tips of posterior rays; anal fin slightly higher than second dorsal fin and both higher than first dorsal fin; second dorsal fin and anal fin densely scaled. Caudal fin forked. Intestine 3.5 times SL.

**DISTRIBUTION.** Ascension Is. Balna, West Indies.

**REMARKS.** Günther placed this species in *Myxus* because of the relatively long teeth, a feature common to most, if not all, juvenile *Mugil* spp. From the other species of *Mugil* with 8 anal rays, *Mugil curvidens* can be distinguished by its teeth, which turn almost at right angles at their tips. In *M. bananensis* the teeth in the upper lip are widely spaced, not close-set as in *M. curvidens* and in *M. trichodon* the teeth in the upper lip are spatulate and those in the lower lip are finer and shorter. Although Valenciennes recorded 9 anal rays, all but 1 of the syntypes has 8, the exception having 7.

#### *Mugil hospes* Jordan & Culver, 1895

*Mugil hospes* Jordan & Culver, 1895: 422, Sinaloa; Jordan & Evermann, 1896: 814, Mazatlan; Boulenger, 1899: 2, Darien; Gilbert & Stark, 1904: 60, Panama Bay; Kendall & Radcliffe, 1912: 58, Sinaloa

*Mugil gamardianus* Pory, 1876: 64, pl. 8, fig. 1-3, Cuba; Jordan & Evermann, 1896: 814, Florida Keys to Cuba, ? non Valenciennes.

**HOLOTYPE.** Stanford University Museum: 2980, Mazatlan, Mexico, coll. Culver & Starks. Not examined.

**MATERIAL EXAMINED.** 9 specimens, 2-225mm, from Brazil, Ecuador, Venezuela, Sarinam and the Pacific coast of Mexico. BMNH: 1845.3.5.5, 145mm, Guiana; 1845.6.4.13, 92mm, Caripe, Venezuela; 1862.12.15.79, 160mm, Guiana; 1895.5.27.178, 175mm, Mazatlan, Mexico (labelled 'syntype'); 1903.5.15.274-5, 214 & 221mm, Panama; 1923.7.30.290, 178mm, Rio de Janeiro; 1938.11.18.45-6, 200 & 225mm, Guayas R., Ecuador. USNM: 47446, 64mm, paratype of *M. hospes*, Mazatlan, coll. Jordan, Culver & Starks.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P (14) 15, L<sub>1</sub> 38-40; tr. 13, ped. 9, pect. sc. 12-14, D<sub>1</sub> sc. 11-13, D<sub>2</sub> sc. 25-26. Scales pavement ctenoid, long narrow mucus canals; no multicanaliculate scales, some secondary squamation dorsally. Body moderately robust, head rounded, scale-free to 1/4 from snout tip to anterior nostril; interorbital almost flat; less than twice eye diameter; eye diameter slightly longer than snout. Upper lip height  $<$  1/4 eye diameter; lip groove c. 1/6 lower lip length. Anterior mandibular pores large, c. breadth of symphyseal knob apart, at rear of symphyseal groove. Rami of lower jaw broadly curving, mandibular angle acute. Single row of teeth in each lip, short and peg-like in upper lip, ciliate in lower; no teeth on pterygoid or domed tongue. Long pointed papillae on mouth membrane. Mouth corner at vertical from posterior nostril; tip of upper jaw on vertical midway between posterior nostril and anterior rim of eye. Preorbital filling c. 1/2 space lip to eye; front and lower edge merge imperceptibly; upper end reaching 1/2 up upper lip, above line joining midpoints of poste-



rior and anterior nostrils. Posterior nostrils not reaching above level of upper rim of eye; anterior nostril wholly below vertical span of posterior. Gill rakers long, type 3.

Pectoral fin reaching front half of eye when laid forward, to vertical from origin of first dorsal fin, or almost so, and c. 3/4 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching rather  $>2/3$  along pelvic spine. First dorsal fin origin nearer snout than to caudal base; sp. 2 longer than sp. 1; sp. 4 short, not reaching past vertical from tip of sp. 3 when fin raised; axillary scale reaching  $1/4$  to  $1/3$  along membrane behind sp. 4. Second dorsal fin origin on vertical  $>1/2$  along anal base; tips of anterior rays not reaching behind tips of posterior rays; anal fin slightly higher than subequal dorsal fins; second dorsal and anal fins densely scaled.

**DISTRIBUTION.** E Pacific from Mexico to Ecuador; W Atlantic from Key West to Brazil.

**REMARKS.** *M. hospes* is the only species of the genus whose pectoral fin reaches the vertical from the origin of the first dorsal fin. It is on this criterion that *M. gaimardianus* of Jordan & Evermann is allocated to this species. Jordan & Evermann recognised *M. hospes* from the Pacific coast only. *M. hospes* is very similar to *M. setosus* in general form; however the latter has several rows of longer teeth, a larger eye and a shorter pectoral fin.

#### *Mugil incilis* Hancock 1830

*Mugil incilis* Hancock, 1830: 127, Guiana; Günther, 1869: 443, Guiana; Steindachner, 1879: 26, San Domingo, Bahia, Chiapan, Demerara; Jordan & Swain, 1884: 266, Antilles, Pacific and Atlantic coasts of central America, N coasts of South America; Jordan & Evermann, 1896: 812, Rio Chagres to Para and Bahia; Vaillant, 1898: 15, Berbice R.; Fowler, 1903: 744, pl. 45, Surinam; Ribiero, 1915: 5, Brazil; Meek & Hildebrand, 1923: 277, Panama; Schultz, 1949: 111, Venezuela.

*Mugil petrosus* Valenciennes, 1836: 89(65), (part), Brazil, Surinam.

*Mugil guthriei* Steindachner, 1864: 211, Guiana.

*Mugil xinguensis* Steindachner, 1907: 489, R. Xingu, Brazil.

*Mysis goniocephalus* Mohr, 1927: 185, fig. 7, East coast, Middle America.

**TYPE.** Neotype (designated here) BMNH 1933.8.2.69, 227mm SL, from the type locality, Guiana, coll. Mathey.

**MATERIAL EXAMINED.** 35 specimens, 30–326mm SL from Guiana, Surinam and Brazil. BMNH: 1845.3.5.6, 81mm, Guiana, 18145. 6.22.35, 233mm, Surinam; 1864.1.26.213-4, 312 & 325mm, Chagres R., Guiana; 1880.10.22.1-2, 110 & 120mm, Demerara; 1925.10.28.473, 48mm, Marajo Is., Brazil; 1926.3.2.970, 164mm, Pyapoek R., French Guiana; 1931.11.3.1-2, 42 & 48mm, Marajo Is.; 1932.11.10.52-3, 205 & 227mm SL, New Amsterdam; 1933.8.2.69, 227mm, neotype of *M. petrosus*.

Berbice, Guiana, coll. Mathey; 1933.8.2.70-2, 3 spec. 114–116mm, Berbice; 1936.5.6.43-4, 104 and 109mm, Surinam; 1961.9.4.66-72, 7 spec. 75–91, Ouwerwagt Ponds, Guiana. MNHN: A.3611, 193mm, syntype of *M. petrosus*, Surinam, coll. Leachpaul; A.3612, 126mm, syntype of *M. petrosus*, Surinam, coll. Lavaillant. ZIZM: H71, 193mm, syntype of *M. goniocephalus*, E coast, central America, coll. 'Hamburg Expedition'; H.173, 5 spec. 30–58mm, paralectotypes of *M. goniocephalus*, E coast, central America, coll. 'Hamburg Expedition'.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> I 8, A III 9, P 17. L<sub>1</sub> 42–45, tr. 13, ped. 9, pect. sc. 12, D<sub>1</sub> sc. 13, D<sub>2</sub> sc. 27. Scales pavement ctenoid, nucleus canals narrow; no multicanalicular scales; some secondary squamation, mostly dorsally. Body robust, head bluntly pointed, scale-free  $<1/2$  distance snout tip to anterior nostril; interorbital slightly convex, less than twice eye diameter; eye diameter longer than snout. Upper lip height  $<1/5$  eye diameter; symphyseal groove slight; lip groove  $1/3$  length of lower lip. Anterior mandibular pores large, others obscure. Rami of lower jaw curving; mandibular angle acute. One row of teeth in each lip, long and curving in upper lip, ciliate in lower; no teeth on pterygoids or domed tongue. Mouth membrane with low irregularly-shaped papillae. Mouth corner at vertical from posterior nostril; tip of upper jaw on line of gape, reaching vertical from anterior rim of eye. Preorbital filling c.  $3/4$  space lip to eye, ending  $1/2$  up upper lip, above line joining midpoints of posterior and anterior nostrils. Posterior nostril extending above level of upper rim of eye; anterior nostril wholly below vertical span of posterior nostril. Gill rakers long, type 5.

Pectoral fin reaching to hind half of pupil when laid forward, not nearly to vertical from first dorsal fin origin and c.  $1/2$  along pelvic fin (not past tip of the pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale reaching  $2/3$  along pelvic spine. First dorsal fin origin nearer snout tip than caudal base; sp. 2 longer than sp. 1; sp. 4 long, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching midway along membrane behind sp. 4. Second dorsal fin origin on vertical c.  $1/2$  along anal fin base; tips of anterior rays not reaching behind tips of posterior rays. Second dorsal fin slightly higher than subequal anal and first dorsal fins; second dorsal and anal fins densely scaled.

**DISTRIBUTION.** Guiana, Surinam and Brazil.

**REMARKS.** The neotype has: depth 54mm, HL 47mm, head width 36mm, interorbital 22mm, eye diameter 13mm, snout length 12mm, MW 16mm, M<sub>1</sub> 12mm, V<sub>1</sub> 34mm; its metrical char-

acters are: D<sub>1</sub> IV, D<sub>2</sub> 18, A III 9, P 16, V 15, LL 45 (left) and 44 (right), tr 13, pect. sc. 12, D<sub>1</sub> sc. 15, D<sub>2</sub> sc. 27. The relative positions of mouth parts and fins are as described above.

The high longitudinal scale count (45) places the syntypes of *M. petrosus* listed above with *M. incilis*, rather than with *M. curema*, though one of the syntypes, MNHN A.3613 is *M. curema*. Steindachner's full descriptions of *M. güntheri* and *M. xinguensis* indicate their synonymy with *M. incilis*. Three other species of *Mugil* with 9 anal rays also have longitudinal scale counts of 40 or more, but of these, only *M. hospes* occurs in the same geographic region as *M. incilis*. In *M. hospes* the pectoral fin reaches the vertical from the first dorsal fin origin, or nearly so. Also in *M. hospes* the posterior nostril is closer to the anterior nostril than the eye, the reverse of *M. incilis*.

### *Mugil liza* Valenciennes, 1836

*Mugil liza* Valenciennes, 1836: 83(61), Brazil, Puerto Rico, Maracaibo, Cuba, Martinique, Surinam, Cayenne, Buenos Aires; Jenyns, 1842: 85, Brazil; Günther, 1861b: 423, West Indies, British Guiana; Steindachner, 1879: 26, Magdalena R., Mexico; (?) Jordan & Swain, 1884: 262, Cuba to Patagonia; Guitart, 1979: 260, fig. 236, Cuba.

*Mugil lebranchii* Poey, 1860: 260, pl. 18, fig. 3, Cuba.

*Mugil liza* Ribiero, 1919: 4, Brazil.

*Mugil brasiliensis* Jordan & Evermann, 1896: 810, Cuba to Patagonia; 1902: 251, Cuba to Patagonia; Evermann & Marsh, 1902: 112, Puerto Rico; Fowler, 1903: 743, Brazil, Surinam, St Martin; 1936: 586, West Indies, Brazil, Surinam; Meek & Hildebrand, 1923: 274, West Indies to Brazil; Schultz, 1949: 111, Venezuela, (?) non Spix.

LECTOTYPE. (By present designation) MNHN A.1051, Cayenne, coll. Frère.

MATERIAL EXAMINED. 6 syntypes and 6 other specimens from the West Indies, Venezuela, Guiana and Surinam. BMNH: 1903.6.9.92, 255mm, Rio de Janeiro; 1906.6.23.80, 140mm, Trinidad; 1924.9.10.88, 150mm, Tobago; 1961.9.4.62, 165mm, Onverwagt Ponds, Guiana. MNHN: A.1050, 555mm, lectotype of *M. liza*, Cayenne, Guiana, coll. Frère; A.4642, 220mm, paralectotype of *M. liza*, Maracaibo, coll. Plée; A.4656, 335mm, paralectotype of *M. liza*, Maracaibo, coll. Plée; A.4567, 369mm, paralectotype of *M. liza*, Maracaibo, coll. Plée; A.4659, 480mm, paralectotype of *M. liza*, Martinique, coll. Plée; A.5763, 620mm, paralectotype of *M. liza*, Martinique, coll. Plée.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> 18, A III 9, P 17, L 1 29-34, tr 13, ped 9, pect. sc. 8, D<sub>1</sub> sc. 9-10, D<sub>2</sub> sc. 19-20. Scales pavement ctenoid, long narrow mucus canals; occasional dorsal and ventral scales with double or Y-shaped canals; secondary squamation. Body slender, head bluntly pointed, scale-free to halfway to anterior nostril from snout tip; interorbital almost flat, less than twice eye diameter in fish under 200mm SL, but greater in larger fish; eye diameter longer than snout. Upper lip thin, lip groove c. 1/4 lower lip length. An-

terior mandibular pores distinct, others obscure. Ramii of lower jaw curving evenly; mandibular angle acute. Teeth in 2 rows in upper lip, 1 in lower; outer row of upper teeth narrow-stemmed, expanding distally, well spaced, inner row bicuspid, outer unicuspid; teeth in lower lip long, fine, close-packed; teeth on pterygoids and laterally on slightly domed tongue. Mouth membrane with rounded papillae. Mouth corner on vertical from posterior nostril; tip of upper jaw on line of gape, reaching vertical from anterior rim of eye. Preorbital filling space lip to eye, reaching 1/2 up upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostrils not reaching above level of upper rim of eye; anterior nostril wholly below vertical span of posterior nostril. Gillrakers long, type 5.

Pectoral fins reaching posterior half of pupil when laid forward in young, to posterior rim of eye in older fish; not reaching vertical from origin of first dorsal fin and about 1/2 along pelvic fin (not past tip of ventral spine; when laid back. Pelvic fin tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching 2/3 along pelvic spine. First dorsal fin origin distinctly nearer snout tip than to caudal base; sp. 2 longer than sp. 1; sp. 4 weak, not reaching vertical from tip of sp. 3 when fin raised; axillary scale reaching c. 3/4 along membrane behind sp. 4. Second dorsal fin origin on vertical c. 1/4 along anal fin base; tips of anterior rays not reaching past tips of posterior rays; second dorsal and anal fins subequal in height, higher than first dorsal; second dorsal and anal fins lightly scaled anteriorly and along base.

DISTRIBUTION. West Indies to Brazil.

REMARKS. *Mugil liza* is the only species of the genus, other than *M. cephalus*, to have bicuspid teeth in the inner rows of the upper lip, though *M. cephalus* usually has more than one such row. *M. liza* has the lowest lateral scale count of any *Mugil* with 8 rays, other than *M. trichodon*, whose second dorsal and anal fins are densely scaled. This species also has only 7 scale rows down the peduncle rather than the 9 of *M. liza*. There are 8 specimens in the Paris Museum labelled as syntypes of *M. liza* of which 6 are stuffed and varnished skins. 2 specimens preserved in alcohol (A.3668 and 6307) have 38 and 37 lateral scale rows compared with the 29-34 shown by the other syntypes and by the several specimens in the British Museum. They also differ in the relative length of the lip groove and in the nature of the scale radii. Because of this ap-

TABLE 8. Biometrics of *Mugil* spp (3). Abbreviations as in Tables 2-4.

Species	<i>M. incilis</i>	<i>M. setosus</i>	<i>M. thoburni</i>	<i>M. trichodon</i>
Scale count	12-14	6-8	8-9	5-12
Depth (%D)	22.8-25.4	23.8-26.1	27.3-28.4	20.8-27.0
HL (%SL)	23.8-25.7	26.0-29.0	27.2-28.6	24.8-30.2
HW (%HL)	66.6-74.3	60.5-66.3	87.0-89.0	77.0-73.0
IO (%HL)	44.5-53.2	39.0-39.5	46.3-47.5	54.0-61.0
ED (%HL)	21.7-25.0	26.7-28.9	28.9-34.4	21.8-24.2
SnL (%HL)	21.2-24.4	21.0-21.5	28.9-29.9	21.8-22.2
ULH (%HL)	4.0-4.5	8	5.8-6.1	5
MW/ML	1.3-1.8	1.2-1.3	1.1-1.2	1.3-1.7
PL (%HL)	72.0-74.4	73.4-76.0	72.0-83.0	85.0-88.0
PB (%PL)	34.6-35.4	25.0-31.0	29.0-36.0	30.0-30.0
PAx (%PL)	38.5-44.0	33.5-36.0	33.3-34.3	30.0-30.0
VL (%PL)	83.3-83.8	75.5-83.5	81.2-83.8	75.0-83.0
VAx (%VL)	40.0-47.5	41.5-45.5	42.3-43.8	43.8-50.0
Ped (%D)	44.0-50.0	42.0-44.0	46.0-47.5	41.0-44.0
TR(UL)	2	2-3	8	1-3
TF(LL)	1	2-3	4	
LES	10-12	2-8	0-3 (2-3) and	5-6
FES	24-8	18-28	5	1-3-6
Sp 2/Sp.1	3.0-3.5	2.0-3.6	4.0	3.0
Sp 3/Sp.2	1.3	1.1-1.2	1.0-1.3	1.0-1.4
GR	50-55	25-30	28-38	21-36
	45-55	32-67	40-52	50-60
PC	2		2	

parent confusion of 2 species amongst the syntypes, MNHN A.1050 is designated lectotype. This specimen, a skin mounted on wood, is 555mm SL and has a formula of D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 8, P. 17, LL. 29, tr 13, ped. 9, pect. sc. 8, D<sub>1</sub> sc. 10, D<sub>2</sub> sc. 19.

### *Mugil setosus* Gilbert, 1891

*Mugil setosus* Gilbert, 1891: 549, Clarion Is.; Jordan & Culver, 1895: 423, Sinaloa; Jordan & Evermann, 1896: 815, Clarion Is.; Mazatlan; Meek & Hildebrand, 1923: 280, Panama.

*Myxus robustus* Mohr, 1927: 189, fig. 11, Panama.

SYNTYPES. USNM 46554 and 48254, Clarion Is., coll. Gilbert, Paralectotype examined.

MATERIAL EXAMINED. 1 paralectotype and 4 specimens from Mexico, Clarion Is. and Sinaloa. BMNH: 1895.5.27.179, 65mm, Mazatlan; 1898.10.29.72, 205mm, Socorro. ZIZM: H.74, 40mm, lectotype of *Myxus robustus*, Sinaloa, coll. Mohr; H.170, 35mm, Paralectotype of *M. robustus*, Sinaloa, coll. Mohr. USNM: 46554, 196mm, syntype of *M. setosus*, Clarion Is., coll. Gilbert.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 16-17, L1 36-38, tr 12-13, ped. 9, pect. sc. 9-10, D<sub>1</sub> sc. 10-11, D<sub>2</sub> sc. 23. Scales pavement ctenoid, narrow mucus canals of variable length; occasional scales on back and flank with 2 canals; secondary squamation present. Body moderately robust; head bluntly pointed, scale-free halfway to anterior nostril from snout tip; interorbital < 1.5 times eye diameter; eye diameter longer than snout; upper lip thicker than in most *Mugil* spp., median height 8% HL; lip groove c. 1/4 lower lip length. Anterior mandibular pores obvious, others obscure. Rami of lower jaw curving, mandibular angle acute. Teeth in 2-5 rows in each lip, unicuspid, outermost row round-stemmed and larger; no teeth on pterygoids or broadly domed, slightly ridged tongue. Mouth membrane papillose. Mouth corner on vertical from posterior nostril; tip of upper jaw on vertical from anterior rim of eye. Preorbital filling only 3/4 space lip to eye; upper end reaching 1/2 up upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostril extending above level of upper rim of eye; anterior nostril slightly overlapping vertical span of posterior nostril. Gill-rakers long, type 5.

Pectoral fin reaching hind edge of pupil when laid forward, just to vertical from first dorsal fin origin in small fish, not so far in large, and c. 1/2 along pelvic fin, (not to tip of pelvic spine) when laid back; axillary scale somewhat rounded. Pelvic fin tip reaching vertical from base of sp. 4 of first dorsal fin or slightly behind; axillary scale reaching > 1/2 along pelvic spine. First dorsal fin origin nearer caudal base than snout tip; sp. 1 shorter than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale long, reaching to end of membrane behind sp. 4. Second dorsal fin origin on vertical c. 1/4 along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal fin and dorsal fins about equal in height; second dorsal and anal fins densely scaled.

DISTRIBUTION. American E coast from Mexico to Panama.

REMARKS. The rounded pectoral fin and round-stemmed teeth distinguish this species within the genus. It differs from the similar *M. incilis* in the lower scale count and in the origin of the second dorsal fin.

### *Mugil thoburni* Jordan & Evermann, 1896

*Mugil thoburni* Jordan & Evermann, 1896: 812, Galapagos Islands, Guatemala; 1902: 254, Galapagos, Guatemala; Gilbert & Stark, 1904: 59, Panama City; Nichols &

Murphy, 1922: 576, Peru; Meek & Hildebrand, 1923: 278, Panama; Herre, 1936b: 94, Galapagos; Hildebrand, 1946: 428, Peru.

*Xenomugil thoburni* Schultz, 1946: 386, Galapagos.

SYNTYPES. USNM 47576, Galapagos, coll. 'Albatross Expedition'. 1 syntype examined.

MATERIAL EXAMINED. 1 syntype and 17 specimens from the Galapagos Islands. BMNH: 1901.6.28.170-1, 155 & 200mm, Narborough Is., Galapagos; 1901.6.28.172-81, 10 spec. 28-162mm, Albemarle Is., Galapagos; 1938.12.12.58, 43mm, Indefatigable Is., Galapagos; 1939.7.10.54, 86mm, Narborough Is. MNHN: 01-160 & 01-190, 4 spec. 64-87mm, locality unknown. USNM: 47576, 119mm, syntype of *M. thoburni*, Galapagos.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 17(18), LI 45-47, tr. 13, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 13, D<sub>2</sub> sc. 28. Scales pavement ctenoid, mucus canal narrow; no multicanalicular scales. Body robust, head bluntly pointed, scale-free to midway from snout tip to anterior nostrils interorbital < 1.5 times eye diameter, slightly convex; eye diameter longer than snout. Upper lip moderately thick, widening posteriorly to conceal lower lip posterior end; lip groove 1/3 lower lip length. Anterior mandibular pores large, others obscure; rami of lower jaw curving inwards laterally, width of gape at mouth corner less than at 3/4 along gape; mandibular angle acute. Teeth unicuspid, 5 rows in upper lip; one row in lower; no teeth on pterygoids or flat tongue; mouth membrane with numerous pointed papillae. Mouth corner at vertical from posterior nostril; tip of upper jaw on vertical midway between posterior nostril and anterior rim of eye. Preorbital filling 1/2 space lip to eye, buried in facial tissue, upper end reaching c.2/3 up upper lip and above line joining midpoints of posterior and anterior nostrils; serrae on lower edge obsolescent. Posterior nostrils reaching above level of upper rim of eye; anterior nostril almost wholly below vertical span of posterior nostril. Gill rakers long, type 4.

Pectoral fin reaching to anterior half of eye when laid forward, not nearly reaching vertical from first dorsal fin origin and c.1/2 along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical between bases of sp. 3 and sp. 4 of first dorsal fin; axillary scale reaching c.1/4 along pelvic spine. First dorsal fin origin equidistant from caudal base and snout tip sp. 1 longer than sp. 2; sp. 4 weak not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/3-1/2 along anal fin base; tips of anterior rays not reaching past tips of posterior rays; anal fin and first dorsal fins heights subequal, higher than second

dorsal fin; second dorsal and anal fins densely scaled.

DISTRIBUTION. Galapagos and Guatemala to Peru.

REMARKS. The peculiar broadening of the upper lip posteriorly distinguishes *M. thoburni* within the genus. This feature led Schultz (1946) to erect monospecific *Xenomugil*. But apart from this feature, *M. thoburni* does not differ fundamentally from other *Mugil*.

### *Mugil trichodon* Poey, 1875

*Mugil trichodon* Poey, 1875: 99, Cuba, nomen nudum; 1876: 66, pl. 8, fig. 4-8, Cuba; Jordan, 1885: 116, Key West; Jordan & Evermann, 1896: 816, Florida Keys to Brazil; Evermann & Marsh, 1902: 113, Puerto Rico; Bean, 1903: 267, New York; Ribiero, 1915: 3, Brazil; Meek & Hildebrand, 1923: 276, Panama; Schultz, 1949: 114, Venezuela; Guitart, 1979: 261, fig. 238, Cuba).

*Queremana gyrans* Jordan & Gilbert, 1884: 26, Key West; Jordan & Swain, 1884: 274, Key West; Jordan, 1885: 116, Key West; Jordan & Evermann, 1896: 818, Woods Hole to Key West.

*Myxus gyrans* Mohr, 1927: 187, fig. 9, Cajanhas, Bahia Honda Is., Key West.

*Mugil brasiliensis* Jordan & Swain, 1884: 270, Cuba, non Spix.

? *Queremana brevirostris* Ribiero, 1915: 7, Brazil.

? *Myxus baronius* var. *costaricensis* Borodin, 1928: 16, Costa Rica, non Günther.

TYPE. None. Type locality, Cuba.

MATERIAL EXAMINED. 20 specimens, 14-95mm SL, F coast of the Americas from Florida to Pernambuco and the West Indies. BMNH: 1884.7.7.164-5, 202 & 205mm, Key West; 1890.1.27.21, 120mm, Pernambuco; 1922.3.8.7-8, 155 and 195mm, Cuba; 1931.12.5.79, 160mm, Teton Bay, Trinidad; 1939.5.12.199-202, 4 spec. 80-90mm, South Sound, Cayman Island; 1967.6.16.280-291, 10 spec. 28-64mm, Morant, Jamaica. USNM: 34966, 2 spec. 14-16mm, syntypes of (2 of 8) *Q. gyrans*, Key West, coll. Jordan.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 8, P 17, LI 30-36, tr. 11, ped. 7, pect. sc. 9, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 24. Scales pavement ctenoid, short mucus canals, some dorsal scales with two canals; some secondary squamation in front of first dorsal fin, not well developed. Body moderately robust; head bluntly pointed, scale-free halfway to anterior nostrils; interorbital less than twice eye diameter; snout shorter than eye diameter. Upper lip distinctly higher medianly than laterally, median height < 1/3 eye diameter; lip groove 1/4 lower lip length. Anterior mandibular pores at base of lower lip, others obscure; mandibular angle acute, 1-3 rows of spatulate teeth in upper lip, those in inner rows finer; 1 row of setiform teeth in lower lip; no teeth on pterygoids or slightly ridged tongue. Mouth membrane without papillae. Mouth corner at vertical from posterior nos-

tril; tip of upper jaw reaching vertical midway between anterior and posterior nostrils; preorbital filling  $3/4$  space lip to eye, upper end reaching  $1/4$  up upper lip and above line joining midpoints of posterior and anterior nostrils. Posterior nostrils reaching slightly above level of upper rim of eye; anterior nostrils entirely below vertical span of posterior. Gill rakers long, type 5.

Pectoral fin reaching to posterior half of pupil when laid forward, not nearly to vertical from first dorsal fin origin and c.  $1/4$  along pelvic fin (not nearly to tip of pelvic spine) when laid back. Pelvic fin tip reaching just behind vertical from base of sp. 4 of first dorsal fin; axillary scale reaching  $>1/2$  along pelvic spine. First dorsal fin origin equidistant from caudal base and snout tip; sp. 2 longer than sp. 1, sp. 4 short, not reaching past vertical from tip of sp. 3 when fin raised. Second dorsal fin origin slightly behind vertical from anal fin origin; tips of anterior rays not reaching behind tips of posterior rays; anal and both dorsal fins approximately equal in height; second dorsal and anal fins densely scaled.

DISTRIBUTION. West Indies and America from Florida to Pernambuco.

REMARKS. *Mugil trichodon* is distinct within the genus in having 7 rays in the second dorsal fin; and from all except *M. curema* in having only 7 rows of scales down the peduncle. *M. curema* has 9 anal rays compared with 8 for *M. trichodon*. *Querimana gyrans* is generally acknowledged to be the young of *M. trichodon* as indicated by the number of rays in the second dorsal fin. The description of Ribiero's (1915) *Querimana brevirostris* suggest that this also may be *M. trichodon*. The poorly described *Myxus harengus costaricensis* of Borodin (1928) may also be this species, but his description could equally apply to *M. liza*, Jordan (1887b) acknowledged that *M. brasiliensis* of Jordan & Swain (1884) was *M. trichodon*.

#### *Sicamugil* Fowler, 1939b

*Sicamugil* Fowler, 1939b: 9. Type species *Mugil hamiltoni* Day, 1869.

DIAGNOSIS. Mouth gape markedly oblique; mid-gape at level of upper rim of pupil; mouth corner at level of lower  $1/3$  of eye, reaching vertical at or behind anterior nostrils; upper jaw end below line of gape, reaching vertical between posterior nostril and anterior rim of eye. Upper lip terminal, thin, of moderate height, without enlarged papillae or crenulations; lower lip thin-edged, directed forwards, not permanently folded down, not entire; symphyseal knob single, high;

lip groove  $1/6-1/2$  lower lip length; no fleshy lobes over ends of jaws or lying freely between rami of lower jaw. Maxilla barely mobile, tendon flange c.  $1/2$  down shaft; maxilla not visible above premaxilla nor below mouth corner when mouth closed; pad over tendon to mouth corner visible; mandibular angle acute in young, obtuse in large fish. Lips edentate; no teeth on vomer, pterygoids or palatines; small teeth on edge of tongue; tongue domed with median ridge. Adipose tissue forming slight rim around eye; preorbital massive with oblique ridge, filling space lip to eye, notched on front edge; interorbital slightly convex; opercular opening reaching under eye. Gill rakers short, type 2. Scales on head extend to lip edge.

Upper insertion of pectoral fin at mid-eye level; no normal pectoral axillary scale, but hard, thickened and enlarged scale immediately above fin insertion. Spine on edge of operculum projecting over pectoral base. First dorsal fin origin variously nearer snout tip or caudal base; second dorsal fin origin at verticals  $1/4-1/2$  along anal fin base; 3 anal spines in adult. Caudal fin shallowly forked. Scales ctenoid, mucus canals of moderate length; no multicanaliculate scales. Stomach with a gizzard; 2 pyloric caeca; intestine 3-5 times SL.

REMARKS. *Sicamugil* is immediately distinguishable from other mugilid genera by the opercular spine. It somewhat resembles *Liza* but lacks the scale-free area on the top of the head, has a lip groove, lacks teeth on the pterygoid and has a spinous edge to the preorbital. Originally attributed to *Mugil* species of this genus were included in *Trachystoma* by Schultz (1946). But *Trachystoma petardi* shows significant differences from *Sicamugil*. In addition to the absence of an opercular spine, the mouth gape is not as oblique, the mid-gape is at mid-eye level, the tendon flange on the maxilla is well above mid-shaft, the dentition is almost complete, being present in both lips and on the vomer, palatines and tongue and the upper insertion of the pectoral fin is higher on the body.

#### KEY TO SPECIES OF *SICAMUGIL*.

1. Scales in longitudinal series  $>40$ ; scales on head etc-noid, with free edges. . . . . *hamiltoni*
- Scales in longitudinal series  $<40$ ; scales on head cycloid, with fused edges. . . . . *lascaris*



TABLE 9. Biometrics of *Sicamugil* and *Rhinomugil* spp. \* continuous series along a curving edge. Abbreviations as in Tables 2-4.

Species	<i>S. cascasia</i>	<i>S. hamiltoni</i>	<i>R. nesiotes</i>	<i>R. sphenomus</i>
Snout length	—	—	—	5
Depth (%SL)	22.5-24.0	25.8-27.5	—	17.5-20.0
HL (%SL)	26.5-27.5	27.0-27.7	24.2-25.5	25.0-26.5
HW (%HL)	7.5-8.5	11.0-11.5	10.0-10.5	6.0-6.5
RO (%HL)	6.0-6.6	14.2-15.1	7.5	15.0-19.2
ED (%HL)	—	24.0-24.3	15.2-15.5	15.0-16.0
Stn. (%HL)	—	20.5-24.0	16.8-18.0	15.2-19.0
ULH (%HL)	5.5	5.5-5.8	6.0-6.3	4.7-5
MW/ML	—	1.2-1.4	1.6-1.7	1.0-1.5
PL (%HL)	75.0-75.1	65.0-69.2	92.0-94.0	62.0-68.0
PB (%PL)	23.0-24.0	24.0-27.3	24.0-25.9	25.0-28.1
PAX (%HL)	na	na	25.0	28.6-35.0
VL (%HL)	—	—	67.2-68.0	61.0-61.5
VAX (%VL)	1.0	1.2-1.4	1.5-1.7	28.6-35.0
Ped. (%D)	78.5-79.0	41.5-41.8	75.5-77.5	56.1-57.0
IR (LL)	0	—	scattered	0
Tr (LL)	—	—	—	—
LES	na	4-5	15-17	2-3
ITS	7-11	7-11	—	5-10
Sp.2/Sp.1	5-10	3-5	—	1-2.5
Sp.3/Sp.2	1-2	1-2	3-5.5	1-1.5
GR	25-26 30-32	75-85 75-85	22-32/ 35-54	335-42/ 45-60
PC	—	2	0	2

***Sicamugil cascasia* (Hamilton Buchanan, 1822)**

*Mugil cascasia* Hamilton Buchanan, 1822: 217, 380, Ganges R.; Valenciennes, 1836: 145(108), North Bengal; Bancroft, 1836: 232, Ganges R.; Bleeker, 1853b: 48, Bengal & Hindustan; Day 1876: 355, pl. 75, fig. 6, Upper Ganges, Jumna, Patna, Brahmaputra, Delhi; 1889: 351, Ganges, Jumna, Patna, Brahmaputra; Munro, 1955: 93, pl. 16, fig. 259, possibly in Ceylon; Pandey & Sandhu, 1992: 274, Upper Ganges & Junaunna Rives & Brahmaputra.

*Liza cascasia* Fowler, 1903: 746, Ganges R.

*Sicamugil cascasia* Pillay, 1962: 264, Fig. 1a, 2, Assam, Yamuna R. at Delhi and Allahabad.

TYPE. None. Type locality, Ganges River.

MATERIAL EXAMINED. 30 specimens, 50-73mm SL from the Ganges River, BMNH: 1870.11.30.59, 10 spec. 53-74mm, Northwest Bengal; 1889.2.1.3726, 60mm, Calcutta; 1889.2.1.3727, 62mm, Gowhatti; 1889.2.1.3728-30, 3 spec. 62-54mm, Assam; 1889.2.1.3731-4, 4 spec. 53-55mm, Jumna R.; 1889.2.1.3735-40, 6 spec. 50-66mm, Delhi; 1889.2.1.3741, 59mm, Sind; 1889.2.1.3742-3, 62 & 65mm, Jaypore; 1934.10.17.107-3, 57 & 61mm, Allahabad. IM: 1392, 74mm, Assam.

DESCRIPTION. D<sub>1</sub> IV D<sub>2</sub> i 8, A III 8, P 13-14, L I 36-39, tr. 13-14, ped. 13, pect. sc. 8, D<sub>1</sub> sc. 6, D<sub>2</sub> sc. 25. Scales ctenoid, elongate, straight-sided; scales on head cycloid and fused to each other. Body slender, head pointed; interorbital less than twice eye diameter; snout length less than eye diameter. Scale on posterior opercular edge about scale's breadth above pectoral fin insertion. Upper lip median height c.1/5 eye diameter; lip groove almost 1/2 lower lip length. Anterior mandibular pores large, about breadth of symphyseal knob apart, 4 obscure pairs behind. Mouth corner at vertical midway between anterior and posterior nostrils; tip of upper jaw at vertical midway between posterior nostril and anterior rim of eye. Preorbital massive, reaching 1/2 up upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostrils not reaching above level of upper rim of eye; anterior nostrils overlapping the lower half of the vertical span of the posterior nostrils; nostrils nearer lip and eye than each other.

Pectoral fin reaching anterior iris when laid forward, reaching vertical from base of sp. 4 of first dorsal fin and <1/2 along pelvic fin (not past tip of pelvic spine) when laid back; normal axillary scale absent, but large thickened scale extending across 3 scale rows immediately above dorsal insertion of pectoral fin. Pelvic fin origin much nearer vertical from first dorsal fin origin than that from origin of pectoral fin; tip of pelvic fin reaching well behind membrane behind sp. 4 of first dorsal fin; axillary scale reaching >1/2 along pelvic spine. First dorsal fin origin nearer snout tip than caudal base; sp. 1 as long as sp. 2; sp. 4 long, reaching behind vertical from tip of sp. 3 when in raised; axillary scale reaching slightly behind base of sp. 4. Second dorsal fin origin on vertical c.1/4 along anal fin base; tips of anterior rays reaching behind tips of posterior; first and second dorsal fins equal to anal in height; second dorsal and anal fins lightly scaled anteriorly and along base; first anal spine unusually short.

DISTRIBUTION. Ganges River. A specimen in the British Museum of Natural History is recorded as from Sind; as no other record outside the Ganges and its tributaries is known this record is suspect.

REMARKS. Besides the points indicated in the key *S. cascasia* differs from *S. hamiltoni* in having the opercular spine situated almost a scale's breadth above the pectoral fin insertion, whereas in *S. hamiltoni* it is immediately above the insertion. The anal rays differ in number and in *S. cascasia* the pectoral fin tip reaches well behind the origin of the first dorsal fin whereas it falls far

short in *S. hamiltoni*. I doubt whether Munro's (1968) view of *cascasia* possibly being in Ceylon is correct; it has never been taken outside the Ganges River and its tributaries.

### *Sicamugil hamiltoni* (Day, 1869)

*Mugil hamiltoni* Day, 1869: 614, Burma; 1876: 354, pl. 75, fig. 5, Rivers of Burma; 1889: 349, Burma; Vinciguerra, 1885: 89, Basseia; 1890: 182, Rangoon.  
*Sicamugil hamiltoni* Fowler, 1939c: 9, fig. 1, Rangoon; Pillay, 1962: 265, fig. 3, Rivers of Burma; Pandey & Sandhu, 1992: 273, Rives of Burma.  
*Trachystoma hamiltoni* Schultz, 1946: 393, Rangoon.

SYNTYPES. BMNH: 1889.2.1.3724-5, coll. Day, Burma. Examined.

MATERIAL EXAMINED. 2 syntypes and 11 other specimens. BMNH: 1870.6.14.45, 89mm, Burma; 1889.2.1.3724-5, 37 & 52mm, syntypes of *M. hamiltoni*, Burma, coll. Day; 1891.11.3.0.80-88, 9 spec. 98-115mm, Sittang R. AM: B.7993, 98mm, Burma.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 13-14, L142-47, tr. 17, ped. 13, pect. sc. 11-12, D<sub>1</sub> sc. 14-15, D<sub>2</sub> sc. 29-30. Scales ctenoid, scales on head ctenoid with free edges. Body slender, head pointed; interorbital about 1.5 times eye diameter; snout not as long as eye diameter; spine on posterior margin of operculum immediately above insertion of pectoral fin. Median height of upper lip c.1/5 eye diameter; lip groove c.1/6 lower lip length. Anterior mandibular pores distinct, about twice symphyseal knob apart, 4 other pairs behind. Mouth corner on vertical from anterior nostrils; tip of upper jaw reaching vertical just in front of anterior rim of eye. Preorbital upper end reaching level of upper rim of lip, above line joining midpoints of posterior and anterior nostrils. Posterior nostrils not reaching above level of upper rim of eye; anterior nostril overlapping lower half of vertical span of posterior nostril; nostrils nearer each other than to lip or eye; slight cutaneous rim around anterior nostril.

Pectoral fin reaching posterior iris when laid back, not nearly to vertical from first dorsal fin origin and a little <1/2 along pelvic fin (not nearly to tip of pelvic spine) when laid back; no normal axillary scale, but a thickened scale, slightly larger than normal scales, above upper insertion of pectoral fin. Pelvic fin origin slightly nearer vertical from pectoral fin origin than to vertical from origin of first dorsal fin, its tip reaching vertical from base of sp. 4 of first dorsal fin or slightly behind; axillary scale reaching c.1/2 along pelvic spine. First dorsal fin origin nearer caudal base than to snout tip; sp. 1 equal in length to sp. 2; sp. 4 weak, its base unusually close to base of sp. 3, not reaching behind vertical from tip

of sp. 3 when fin raised; axillary scale reaching between bases of sp. 3 and sp. 4.

DISTRIBUTION. Burma, in rivers.

REMARKS. Fowler (1939c) described *S. hamiltoni* as having 'scales 30 to 32 in lateral series'. He also stated that the snout was longer than the eye diameter (snout 26.6-27.3% HL in his fish compared with 20.5-24.0% in those described here). Either there was an error in Fowler's records or there is a third unrecognised species of *Sicamugil*.

Besides the syntypes below, specimens from Day's collection exist in 3 other museums, including the Calcutta Museum (Whitehead & Talwar, 1976). Distinction between this species and *S. cascasia* are noted in discussing the latter.

### *Rhinomugil* Gill, 1864

*Rhinomugil* Gill, 1864: 6191. Type species *Mugil corsula* Hamilton Buchanan, 1822.  
*Squadamugil* Ogilby, 1908: 3 & 28. Type species *Mugil nayutta* De Vis, 1883.

DIAGNOSIS. Mouth gape very slightly oblique, mid-gape at level of mid-pupil in young dropping to level of lower rim of eye or below in large fish; mouth corner at level below lower rim of eye, reaching under eye in larger fish; tip of upper jaw reaching under eye. Upper lip thin, recessed under overhanging snout, without enlarged papillae or crenulations; lower lip thin-edged, not entire, with single high symphyseal knob; lip groove very short; no fleshy lobes over jaw ends or lying freely between rami of lower jaw. Maxilla slightly mobile, tendon flange 1/2-2/3, down shaft; maxilla not visible above premaxilla or below mouth corner when mouth closed. Mandibular angle acute to obtuse. Upper lip with or without fine teeth; lower lip edentate; no teeth on vomer, pterygoids, palatines or tongue; tongue domed with slight median ridge. Adipose tissue extending over iris with almost vertical edges to the slit, leaving mid-dorsal and mid-ventral iris uncovered; eyes raised above dorsal contour of head; interorbital concave. Preorbital slender, not notched but gently concave; nostrils nearer eyes and lips than each other; anterior nostrils at level of lower half of eye.

Upper insertion of pectoral fin below mid-eye level; axillary scale short; pelvic fin origin nearer vertical from origin of pectoral fin than to vertical from first dorsal fin origin; first dorsal fin origin nearer caudal base than snout tip; second dorsal fin origin over posterior quarter of anal fin base; 3 anal spines in adults; caudal fin slightly forked.

Scales pavement ctenoid with long mucus canals; no multicanalicate scales; scale-free area on head negligible. No spine on operculum. Stomach with a gizzard; pyloric caeca 2 or 16; intestine 3-5 times SL.

REMARKS. *Rhinomugil* is distinguished from all other mugilids by the eyes raised above the dorsal contour of the head, permitting aerial vision. It shares with *Joturus* the overhanging snout, but the upper lip is thin, not thick as in that genus. Ogilby apparently named his genus in ignorance of Gill's work. Taylor (1964) retained Ogilby's generic name on the basis of the different position of the nostrils in the 2 species recognised here. But in other respects the 2 species are so much alike that this variation is more reasonably regarded as a specific difference.

#### KEY TO THE SPECIES OF *RHINOMUGIL*.

1. More than 40 scales in longitudinal series; both nostrils below level of lower eye rim (India) . . . *squamipinnis*  
Fewer than 40 scales in longitudinal series; posterior nostril at upper eye level, anterior below mid-pupil level (Australia). . . . . *nasutus*

#### *Rhinomugil nasutus* (De Vis, 1883)

*Mugil nasutus* De Vis, 1883: 621, Cardwell, Rockingham Bay (Queensland); Macleay, 1885: 42, Rockingham Bay. *Squalomugil nasutus* Ogilby, 1908: 28, Queensland coast; Partridge & Whitley, 1927: 96, Adam's Bay, (Darwin); Whitley, 1941: 22, fig. 16, Cardwell; Marshall, 1964: 404, col. pl. 54, N Queensland; Taylor, 1964: 121, Arnhem Land.

*Rhinomugil nasutus* Schultz, 1946: 384, Queensland coast; Thomson, 1954: 122, fig. 16, Cardwell, McKenzie Is., Adam's Bay, Princess Charlotte Bay.

HOLOTYPE. QM I.120, Cardwell, Rockingham Bay, coll. De Vis.

MATERIAL EXAMINED. Holotype and 7 other specimens from Queensland and the Northern Territory. BMNH: 1952.4.2.1, 90mm, Marauke, West Irian. AM: I.12693, 122mm, Cardwell (labelled co-type); IA.3066, 92mm, Adam's Bay (Darwin); IB. 1751-4, 4 spec. 62-68mm, McKenzie Is. (Darwin Harbour). QM: 1120, 210mm, holotype of *M. nasutus*, Cardwell, coll. Broadbent.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 7, A III 8, P. 12-13, L1 34, tr. 11, ped. 7, pect. sc. 10-11, D<sub>1</sub> sc. 10-11, D<sub>2</sub> sc. 20-21. Scales pavement ctenoid. Body slender, head pointed, dorsal profile almost straight, but dipping down in front of eye; interorbital narrow, concave, <1.5 times eye diameter; snout length <eye diameter. Upper lip median height <1/3 eye diameter. Anterior mandibular pores large, breadth of symphyseal knob apart, 3 pairs behind. Mandibular angle obtuse. Some specimens with fine spatulate teeth in upper lip, absent in others. Tongue slightly domed with a

high median ridge. Mouth corner on vertical from anterior half of eye; tip of upper jaw reaching vertical from mid-pupil. Preorbital filling space lip to eye, upper end 3/4 up upper lip, above line joining midpoints of posterior and anterior nostrils; posterior nostril in normal position, not reaching above level of upper rim of eye; anterior nostrils with high cutaneous rim, below mid-pupil level, well below posterior nostril, facing forward on anterior aspect of snout. Gill rakers short, type 3.

Pectoral fin reaching mid-eye when laid forward, reaching vertical from base of sp. 2 of first dorsal fin and c.3/4 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical 1/2 along membrane behind sp. 4; axillary scale reaching <1/2 along pelvic spine. Sp. 1 of first dorsal fin longer than sp. 2; sp. 4 slight, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical almost at posterior end of anal base; tips of anterior rays just reaching past tips of posterior rays; anal fin and second dorsal fin subequal, higher than first dorsal fin; second dorsal and anal fins densely scaled. Pyloric caeca 16.

DISTRIBUTION. Tropical Australia and southern shores of New Guinea.

REMARKS. *R. nasutus* is distinguished from the only other member of the genus, *R. squamipinnis*, by the fewer lateral and transverse scales, 7 rather than 8 dorsal rays, retention of the posterior nostril at the level of the upper eye, and geographic segregation.

#### *Rhinomugil squamipinnis* (Swainson, 1820)

*Mugil squamipinnis* Swainson, 1820: 234 & 413, Ganges R. *Mugil corsula* Hamilton Buchanan, 1822: 221, pl. 9, fig. 17, Ganges R., Bengal; Valenciennes, 1836: 119(88), Ganges R.; Eydoux & Souleyet, 1841: 172, pl. 4, fig. 2, Ganges R.; Bleeker, 1853b: 101, Bengal; Günther, 1861b: 460, Calcutta; Day, 1876: 354, pl. 71, fig. 6, Bengal, Calcutta, Burma; 1889: 349, Calcutta, Bengal, Burma; Vinciguerra, 1890: 181, Rangoon, Mandalay, Bhamo; Pandey & Sandhu, 1992: 272, Calcutta, rivers and estuaries of Bengal and Burma.

*Liza corsula* Chaudhuri, 1917: 498, Chilka L.

*Rhinomugil corsula* Schultz, 1946: 384, Rangoon; Pillay, 1962: 568, pl. 2, fig. 5, Bengal, Burma).

TYPE. None. Type locality, Ganges River.

MATERIAL EXAMINED. 18 specimens, 53-95mm, from the Ganges R. and tributaries and from Burma. BMNH: 1889.2.1.3721, 102mm, Calcutta; 1889.2.1.3722-3, 65 & 144mm, Bengal; 1891.11.30.89-98, 14 spec. 95-234mm, Sittang R. Burma; 1934.10.17.106, 93, Allahabad.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 8(9), P 15-16, I 145-47, tr. 15-16, ped 11, pect sc. 13-14, D<sub>1</sub> sc. 17, D<sub>2</sub> sc. 32-33. Scales ctenoid, mucus canals long and sinuous, penetrating posterior segment to base of ctenii. Body slender, elongate, head bluntly pointed, upper profile straight to snout tip; interorbital only slightly longer than eye diameter; snout and eye diameter subequal; median upper lip height  $\sim 1/2$  eye diameter. Anterior mandibular pores large, posterior pairs obscure; mandibular angle acute. Both lips edentate; tongue high-domed with slight median ridge; abundant papillae on mouth and tongue membranes. Mouth corner on vertical just in front of anterior rim of eye in small fish, moving back to vertical from mid-eye in large fish. Preorbital slender, filling only  $1/2$  space lip to eye, front end reaching level of upper rim of lip and on line joining midpoints of anterior and posterior nostrils. Both nostrils below level of lower rim of eye; posterior on vertical from anterior rim of eye, anterior nostril at vertical  $1/3$  distance from eye to snout tip, entirely within vertical span of posterior nostril; posterior nostril nearer eye than anterior to lip; prominent raised cutaneous rim around anterior nostril. Gill rakers short, type 4.

Pectoral fin reaching to mid-eye when laid forward, not nearly to vertical from first dorsal fin origin, but c.  $2/3$  along pelvic fin (past tip of pelvic spine) when laid back; axillary scale rudimentary or absent. Pelvic fin tip reaching vertical from origin of first dorsal fin; axillary scale reaching half along pelvic spine. Sp. 1 of first dorsal fin equal to sp. 2 in length; sp. 4 long, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale variably developed. Second dorsal fin origin at vertical  $3/4$ - $4/5$  along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin and second dorsal equal in height, higher than first dorsal fin; second dorsal and anal fins densely scaled. Pyloric caeca 2.

**DISTRIBUTION.** Ganges River and its tributaries to Burma.

**REMARKS.** Swainson's description has been overlooked; brief though it is, there can be no doubt that his *M. squamipinnis* is identical with Hamilton Buchanan's *M. corsula*. The distinction between this species and *R. nasutus* has been discussed under the latter species.

#### *Valamugil* Smith, 1948

*Valamugil* Smith, 1948: 811. Type species *Mugil schultzei* Forsskal, 1775.

*Moulgarda* Whitley, 1945: 14 (part). Type species *Moulgarda pinn* Whitley, 1941.

*Osteomugil* Luther, 1977: 7. Type species *Mugil curmuseus* Valenciennes, 1836.

**DIAGNOSIS.** Mouth gape moderately oblique; mid-gape at level of upper half of pupil; mouth corner at level of lower rim of pupil or of lower iris and reaching vertical from posterior nostril or behind it; tip of upper jaw below line of gape, reaching vertical between midpoint from posterior nostril and anterior rim of eye and the eye. Upper lip terminal, thin, of variable height, without enlarged papillae or crenulations; lower lip thin-edged, not folded down, not entire; symphyseal knob single or double; lip groove short, no fleshy lobes over end of jaws or lying freely between lower jaw rami. Maxilla slightly mobile, its tendon attached  $>1/2$  down shaft, curving in one plane from flange to jaw end, not visible below mouth corner when mouth closed, but pad over tendon to mouth corner visible in some species. Mandibular angle obtuse, except in young *V. speigleri*. Teeth labial, fine, usually more abundant on lower lip than on upper; no teeth on vomers or palatines, but present on pterygoids and tongue. Tongue with high keel-like ridge in young, becoming domed in older fish. Adipose tissue variously developed. Interorbital almost flat; preorbital notched, filling space lip to eye or almost so. Posterior nostril equidistant from anterior nostril and eye; anterior nostril nearer lip than posterior nostril; posterior nostril reaching above level of upper rim of eye; anterior nostril either completely below vertical span of posterior nostril or overlapping only slightly.

Upper insertion of pectoral fin at level of upper rim of eye; axillary scale long and pointed; pelvic fin origin nearer vertical from pectoral fin origin than to that from the first dorsal fin origin; first dorsal fin origin variably nearer caudal base or snout tip; second dorsal fin origin varying from opposite anal fin origin to  $1/3$  along anal fin base. 3 anal spines in adults. Scales, other than on breast, cycloid with a membranous flexible fimbriate posterior margin; breast scales variably either ctenoid throughout life or only in young. No spine on operculum. Stomach with gizzard; pyloric caeca 6 in most species, some with more and one with only 4; intestine 4-6 times SL.

**REMARKS.** The peculiar flexible fimbriate margin to the scales is otherwise found only in *Crenimugil* spp. In young specimens the scales may be typically cycloid, the membranous edge developing later. *Crenimugil* differs in having enlarged papillae and crenulations on the lips above a certain size, and in having a thick lower lip. Species of *Valamugil* have sometimes been assigned to

*Liza*, especially those species in which the pad over the tendon to the mouth corner is exposed when the mouth is closed, as this has been equated to 'maxilla exposed below mouth corner' defining *Liza*. But the visible pad of *Valamugil* is homologous with the smaller pad visible in *Liza* in front of the pad over the maxilla. Also *Liza* spp. lack the long pectoral axillary scale, the mouth gape does not extend as far posteriorly, there is no lip groove and the nostrils are differently spaced. The position of *Moolgarda* Whitley, 1945 is complex. No type specimens of *Moolgarda pura* were retained. Whitley (1945) referred to large pectoral axillary scales, the absence of papillae on the lips, an adipose eyelid 'not reaching the pupil' which are typical of *Valamugil*. He also mentioned that some specimens lacked the axillary scale and had LI 29-35 compared with the 36 in his generic description. All the specimens in the Australian Museum labelled *M. pura* (and none are labelled as types) are *Liza subviridis* (*Liza dussumieri* of Thomson, 1954) which lack the pectoral axillary scale. It would seem that more than one species has been confused in Whitley's description. Whitley also described *M. (Planiliza) ordensis* but his specimens in the Australian Museum are *Liza alata* Steindachner. All the extant specimens of *Moolgarda* appear to be specimens of *Liza*, yet Whitley's basic description suggests *Valamugil*.

#### KEY TO THE SPECIES OF VALAMUGIL.

1. Pectoral fin < 75% HL, not reaching vertical from origin of first dorsal fin (SE Africa) . . . . . *robustus*
- Pectoral fin > 75% HL, reaching vertical from first dorsal fin origin (except in very small fish) . . . . . 2
- 2(1). Adipose tissue only a rim around eye . . . . . 3
- Adipose tissue intruding over eye . . . . . 4
- 3(2). Scales in longitudinal series 38-42 (Indo-Pacific) . . . . . *seheli*
- Scales in longitudinal series 32-35 (Indo-Pacific) . . . . . *buchanani*
- 4(2). First dorsal fin origin nearer caudal base than to snout tip . . . . . 5
- First dorsal fin origin nearer snout tip than to caudal base . . . . . 6
- 5(4). Caudal peduncle < 45% body depth; second dorsal and anal fins densely scaled (Indo-Pacific) . . . . . *engeli*
- Caudal peduncle 50% or more of body depth; second dorsal and anal fins scaled along base and anteriorly (E Australia). . . . . *georgii*
- 6(4). Scales in longitudinal series 30-35 (Indo-Pacific) . . . . . *curmesius*
- Scales in longitudinal series 37-40 (India to Queensland). . . . . *speigleri*

#### *Valamugil buchanani* (Bleeker, 1853b)

- ? *Mugil albula* Hamilton Buchanan, 1822: 218, Hooghly R., non Linnaeus.
- Mugil buchanani* Bleeker, 1853b: 99, Hooghly R.; Day, 1876: 358, Seas of India, ascending rivers; 1889: 354, Seas of India; Fowler, 1928a: 123, Marianas; Smith, 1935: 623, fig. 12, pl. 16, fig. D, Knysna, Durban, Chinde.
- Valamugil buchanani* Smith 1948: 841, fig. 13, Knysna, East London; 1949: 323, fig. 888, Indo-Pacific; Thomson, 1954: 110, pl. 2, fig. 2, NW Australia, Amboina, Durban; Munro, 1955: 92, pl. 16, fig. 253, Ceylon; 1967: 170, pl. 18, fig. 288, New Guinea; Fourmanoir, 1957: 73, Nosi-Bé, Anjuan; Taylor, 1964: 120, Arnhem Land; Masuda et al, 1984: 120, pl. 105, fig. B, Japan; Kurunuma & Abe, 1986: 210, Kuwait market.
- ? *Mugil radians* Castelnau, 1861: 49, South Africa; Gilchrist & Thompson, 1916: 273, E coast South Africa; 1917: 317, E coast South Africa.
- Mugil ceylonensis* Günther, 1861b: 446, fig., Ceylon; Gilchrist & Thompson, 1911: 43, Natal; Boulenger, 1916: 93, fig. 55, Zanzibar, Kosi Bay; Barnard, 1925: 305, Natal, Zululand, Delagoa Bay, Chinde.
- Oedalechilus kesteveni* Whitley, 1943: 178, Port Essington.

HOLOTYPE. RMNH 6383 Hooghly River, coll. Bleeker.

MATERIAL EXAMINED. Holotype and 16 specimens, 88-415mm SL, including the types of *M. buchanani*, *M. ceylonensis* and *O. kesteveni* from Mauritius, Zanzibar, Western Australia and the W Pacific. BMNH: 1860.3.19.792-4, 3 spec. 46-104mm, syntypes of *M. ceylonensis*, Ceylon, coll. von Schlagentweit; 1866.1.1.9.5, 109mm, Hooghly R.; 1867.3.7.509, 228mm, Zanzibar; 1867.3.9.238-9, 122 & 148mm, Zanzibar; 1877.4.18.1, Raiatea; 1881.10.20.59, 260mm, Ponape, Caroline Is; 1906.11.19.45, 415mm, Kosi Bay, South Africa; 1934.2.22.56, 242mm, Mauritius; 1948.10.15.3, 183mm, Sabaki R., Kenya. RMNH: 6383, 103mm, holotype of *M. buchanani*, Googhly R., coll. Bleeker. AM: A4797, 157mm, holotype of *O. kesteveni*, Port Essington, coll. Whitley; I.94, 173mm, Amboina; I.15225, 186mm, GuadalCanal.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 18, LI 32-35, tr. 12, ped. 9, pect. sc. 10, D<sub>1</sub> sc. 9, D<sub>2</sub> sc. 19-21. Scales with moderately long mucus canals, reaching inner edge of membranous margin only on breast scales; occasional dorsal scales with 2 canals. Body robust, head bluntly pointed, scale-free to posterior nostril; interorbital twice eye diameter in large fish, gently convex; snout not as long as eye diameter. Adipose tissue rim around eye. Upper lip median height c. 1/4 eye diameter; lip groove c. 1/5 lower lip length. Anterior mandibular pores large, rather more than symphyseal knob breadth apart; others obscure. Rami of lower jaw almost straight. Teeth well-spaced, sparser in upper lip; tongue domed, slight median ridge; papillae on mouth and tongue membranes flattened anteroposteriorly. Mouth corner on vertical from posterior nostril; tip of upper jaw reaching vertical midway between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner not visible when mouth closed. Preorbital reaching 1/2 up upper lip and to



TABLE 10. Biometrics of *Valamugil* spp (1). Abbreviations as in Tables 2-4.

Species	<i>V. buechanani</i>	<i>V. cunnesius</i>	<i>V. engeli</i>	<i>V. georgii</i>
Scale radii	6-7	7-8	4-5	6-8
Depth (%SL)	29.1-31.0	26.0-28.5	27.4-31.2	29.0-31.2
HL (%SL)	25.0-26.0	24.0-25.8	24.8-26.4	24.2-25.1
HW (%HL)	72.2-82.1	66.8-68.0	71.5-74.2	67.5-68.0
IO (%HL)	46.3-48.0	44.6-48.5	45.0-48.0	43.0-44.5
ED (%HL)	23.0-28.5	27.3-28.8	25.7-29.0	27.0-28.2
SnL (%HL)	19.5-23.5	19.5-21.5	22.0-25.2	20.3-27.0
ULH (%HL)	5.4-7.0	3.5	4.0-4.5	5.0-5.8
MW/ML	2.6-2.8	2.0-2.6	2.0-2.2	2.7-2.9
PL (%HL)	91.0-96.0	96.0-100	88.0-90.5	90.1-91.8
PB (%PL)	27.0-29.0	29.0-30.0	23.0-25.0	37.0-37.6
PAX (%PL)	30.0-33.0	40.0-46.0	30.0-35.7	35.5-39.0
VL (%PL)	74.0-77.0	70.0-73.0	76.0-78.8	77.5-78.5
VAX (%VL)	38.0-48.0	48.0-54.0	47.3-51.2	42.0-42.5
Ped (%D)	42.5-47.0	45.8-48.4	40.0-40.5	50
TR(UL)	scattered	scattered	scattered	scattered
TR(1.L.)	scattered	scattered	scattered	0
LES	15-22	10-17	12-18	10-16
FES	17-25	11-23	10-19	15-20
Sp.2/Sp.1	3.0-3.4	4.0-4.5	2.4	2.8
Sp.3/Sp.2	1.4-1.7	1.5	1.7	1.5
GR	31-41/ 41-52	28-36/ 33-50	20-32/ 45-48	22-36/ 32-48
PC	6	6	6	14

line joining midpoints of posterior and anterior nostrils. Anterior nostrils almost entirely below vertical span of posterior nostrils. Gill rakers of moderate length, type 3.

Pectoral fin reaching between anterior half of eye and posterior nostril when laid forward, reaching vertical from origin of first dorsal fin and c.3/4 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical behind base of sp. 4 of first dorsal fin; axillary scale reaching c.1/2 along pelvic spine. First dorsal fin origin equidistant from caudal base and snout tip; sp. 1 equal to sp. 2 or longer, sp. 4 short, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin almost on vertical from anal fin origin, tips of anterior rays reaching well behind tips of posterior rays; anal fin height equal to second dorsal fin, but higher than first dorsal fin; second dorsal and anal fins densely scaled, falcate; caudal fin falcate, deeply forked. Pyloric caeca 6.

DISTRIBUTION. Indian Ocean to W Pacific, from Zanzibar to Raiatea, Society islands.

REMARKS. The high falcate fins are characteristic, though also found in *Liza alata*. The absence of adipose tissue over the iris distinguishes *V. buechanani* from all other members of the genus except *V. seheli*. The pectoral fin of *V. seheli* reaches well behind the vertical from the origin of the first dorsal fin and the species has a higher lateral fin count than *V. buechanani*.

The syntypes of *M. ceylonensis* correspond with the type of *M. buechanani* in every respect.

### *Valamugil cunnesius* (Valenciennes, 1836)

*Mugil cunnesius* Valenciennes, 1836: 114(84), Moluccas, Malabar, Bombay; Bleeker, 1852d: 454, Banka; 1853b: 48, Bengal; 1858a: 385, Java; 1859a: 278, Indonesian archipelago; 1860e: 8, Sumatra; Klunzinger, 1870: 830, Red Sea; 1884: 132, Red Sea; Day 1876: 349, pl. 74, fig. 3, Bombay, Malaya; 1889: 342, Seas of India; Weber, 1895: 261, Ambon; Chaudhuri, 1917: 496, Chilka L.; Weber & De Beaufort, 1922: 292, Singapore, West Irian; Barnard, 1925: 304, Delagoa Bay; Pellegrin, 1933: 172, fig. 94, Madagascar; Devasundaram, 1951: 22, Chilka L.; Pillay, 1962: 563, (part), Chilka L., Cochin, W Bengal; Pandey & Sandhu, 1992: 262, fig. 59, Bombay, Red Sea to Malay Archipelago and beyond.

*Valamugil cunnesius* Thomson 1974: FAO Identification sheet; Masuda et al., 1984: 120, pl. 105, fig. C, Japan; Shen, 1994: 440, pl. 138, fig. 6.

*Mugil perusii* Valenciennes, 1836: 116(86), Vanicolo; Günther, 1861b: 422, Vanicolo; 1877: 214, Vanicolo.

*Mugil amarulus* Valenciennes, 1836: 133(98), Java, Coramandel, Pondicherry; Bleeker, 1853b: 48, Hindustan; 1855c: 400, Java; 1860c: 80, Borneo; Day, 1876: 356, Sind, India, Java; 1889: 352, Seas of India; Roxas, 1934: 419, Philippines.

*Liza amarula* Jordan & Seale, 1907: 11, Luzon.

*Mugil strongylocephalus* Richardson, 1846: 249, Hong Kong, China seas; Günther 1861b: 425, fig., Hong Kong, China seas; Fowler, 1935: 139, Hong Kong; Smith, 1935: 606, fig. 5, pl. 16, fig. A, Durban, Isipingo, Beira, Bay of Bengal; 1948: 836, fig. 4, Durban to Delagoa; 1949: 318, fig. 879, Indo-Pacific south to Durban; Marshall, 1964: 408, pl. 54, fig. 387, Queensland.

*Liza strongylocephalus* Thomson, 1954: 96, fig. 6, Pellew Is., Adam's Bay, Bombay, Isipingo; Munro, 1955: 93, pl. 16, fig. 225, Ceylon; 1967: 168, pl. 18, fig. 280, New Guinea.

*Chelon strongylocephalus* Taylor, 1964: 118, Arnhem Land.

*Mugil ophiosema* Bleeker, 1859a: 279, Indonesia; 1860c: 82, Sumatra; Günther, 1861b: 434, Sumatra; Kner, 1865: 226, pl. 9, fig. 2, Java; Weber & De Beaufort, 1922: 240, Sumatra, Java, Salibaba Is.; John, 1955: 227, Kyamkulam L.; Munro, 1967: 168, New Guinea.

*Mugil longimanus* Günther, 1861b: 428, East Indies; Klunzinger, 1880: 395, Cleveland Bay; Steindachner, 1880: 5, Cleveland Bay; De Vis, 1884: 870, Brisbane market; Macleay, 1885: 41, Cleveland Bay; Jordan & Seale, 1907: 10, Luzon; Seale, 1914: 61, Hong Kong; McCulloch, 1921: 130, Cleveland Bay, Bombay; Weber & De Beaufort, 1922: 239, Singapore, Sumatra, Ambon, Bunka, Madura, Java, Celebes, Moluccas; Fowler, 1925a: 208, Delagoa Bay; 1927a: 9, Christmas Is., Palmyra Is.; 1928a: 209, Ceylon; 1938a: 17, Hong Kong; 1938b: 121, Opatakin, Tahiti, Moorea; Paradise & Whitley, 1927:

- 81, Pellew Is., Roxas, 1934: 405, pl. 1, fig. 3, Philippines; Herre, 1936b: 94, Bushman Bay, Malekula Bay, New Guinea; John, 1955: 226, Kyamkulam L., Scott, 1959: 142, fig., Malaya.
- Mugil kelaarti* Günther, 1861b: 429, Pointe de Galle (Ceylon), Philippines; 1877: 215, pl. 121, fig. A, Tahiti; 1881: 25, Ceylon, Philippines; Day, 1876: 352, pl. 75, fig. 1, Madras, India, Philippines; 1889: 346, India, Philippines; Oshima, 1922: 248, Taiwan; Whitehouse, 1927: 87, Madras; Munro, 1955: 92, pl. 16, fig. 352, Ceylon; Pandey & Sandhu, 1992: 268, Madras, India to Philippines.
- Mugil kellaarti* Steindachner, 1906: 1416, Samoa.
- Mugil acheronoides* Duncker & Mohr, 1926: 133, figs 7-8, New Britain, C. Beachy, Simpson Hbr, Jacquinot Bay, Montague Bay.
- Mugil dussumieri* Whitley, 1941: 24, New Hebrides, non Valenciennes.

HOLOTYPE. MNHN A.4636, Moluccas, coll. unknown.

MATERIAL EXAMINED. Holotype and 40 specimens, 30-150mm from the Red Sea, India, Ceylon, Malaya, Indonesia, Philippines, N Australia and Santa Cruz Is. BMNH: 1843.8.17.9, 89mm, paratype of *M. kelaarti*, Philippines; 1845.11.10.16, 101 & 109mm, China; 1855.8.15.24, 132mm, holotype of *M. longimous*, Indonesia, coll. Waterhouse; 1859.5.7.38, 88mm, holotype of *M. kelaarti*, Pt de Galle, Ceylon; 1889.2.1.3677, 110mm, Madras; 1889.2.1.3678-9, 125 & 150mm, Mangalore; 1889.2.1.3680, 150mm, Bombay; 1889.2.1.3701, 72mm, Bombay; 1889.2.1.3777, 100mm, Malabar; 1889.2.1.3778, 77mm, Bombay; 1889.2.1.3780 83mm, Sind; 1897.1.28.22, 64mm, Penang; 1913.12.9.191-2, 65 & 104mm, Miluka R., New Guinea; 1960.3.15.1701-5, 61 & 62mm, Merau, Red Sea; 1972.11.29.1, 142mm, holotype of *M. strongyloccephalus*, Hong Kong, coll. Richardson. MNHN: A.3645, 140mm, holotype of *M. perusii*, Vanikoro, coll. Quoy & Gaimard; A.3701, 2 spec. 123mm, paratypes of *M. cunnesius*, Bombay, coll. Dussumier; A.3702, 105 & 108mm, paratypes of *M. cunnesius*, Bombay, coll. Dussumier; A.3720, 63mm, syntype of *M. amarus*, Java, coll. Kuhl & Van Hasselt; A.3721, 4 spec. 30-35mm, syntypes of *M. amarus*, Pondichery, coll. Leschenault; A.3722, 52mm, syntype of *M. amarus*, Bombay, coll. Dussumier; A.3726, 120 & 138mm, paratypes of *M. cunnesius*, coll. unknown. RMNH: 4394, 83 & 143mm, syntypes of *M. ophiosenni*, Indonesia, coll. Bleeker. ZIZM: 11.163, 18mm, lectotype of *M. acheronoides*, New Britain, coll. Süder expedition. AM: 1A.7682-4, 3 spec. 108-124mm, Northern Territory.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A ii 9. P 16(17). Ll 30-36, tr. 11, ped. 7, pect. sc. 12, D<sub>1</sub> sc. 10, D<sub>2</sub> sc. 21. Scales with long mucus canals, not reaching inner edge of marginal membrane except on breast scales; occasional anterodorsal scale with 2 canals; slight secondary squamation. Body moderately robust, head roundly pointed, scale-free to just behind posterior nostrils; interorbital ~1.5 times eye diameter, slightly convex; snout shorter than eye diameter. Adipose tissue reaching 1/2 over iris. Upper lip median height 1/7 eye diameter; symphyseal knob single, not projecting in front of lip; lip groove c. 1/3 lower lip length. Anterior mandibular pores large, about breadth of symphyseal knob apart, second pair twice as far apart, others obscure. Long ciliiform teeth spaced on upper lip; shorter irregularly spaced teeth on lower lip, sometimes absent. Tongue flat with

median ridge. Mouth corner at vertical midway between posterior nostril and eye; tip of upper jaw reaching vertical from anterior rim of eye. Pad over tendon to mouth corner visible when mouth closed. Preorbital upper end reaching just below upper rim of upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostril not reaching above upper rim of eye; anterior nostril entirely below vertical span of posterior nostril. Gill rakers long, type 5.

Pectoral fin reaching to between nostrils and snout tip when laid forward, to vertical midway between bases of sp. 3 and sp. 4 of first dorsal fin and 3/4 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 4; axillary scale not quite to tip of pelvic spine. First dorsal fin origin nearer snout tip than caudal base; sp. 1 equal to or longer than sp. 2; sp. 4 short, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale long, reaching behind end of membrane behind sp. 4. Second dorsal fin origin at vertical about 1/3 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin higher than second dorsal fin and both higher than first dorsal fin; second dorsal and anal fins moderately scaled, the rays not being obscured, but the membrane densely covered. Pyloric caeca 6.

DISTRIBUTION. Indian Ocean and W Pacific, from Nari to Australia, Philippines and China.

REMARKS. Species of *Valamugil* are very similar. Typical *M. perusii* seem to differ from *V. cunnesius*. However when grouped on the basis of differences in the dentition and gill-raker lengths, smaller specimens sort as *V. perusii* and larger ones as *V. cunnesius*. Day's (1889) description of *M. cunnesius* does not distinguish his specimens from *V. engeli*. There is also doubt about his *M. amarus* which he described as lacking adipose eyelids. Steindachner (1906) described under the name *M. kelaarti* a fish said to have the pectoral fin just reaching the origin of the first dorsal fin and having the origin of the first dorsal fin nearer the caudal base than the snout tip, which points more to *V. engeli* than to *M. kelaarti* (= *V. cunnesius*). Klunzinger (1884) does not appear to have had specimens of *M. cunnesius* before him as he stated that his specimens had 40-42 scales in the longitudinal series. In having the adipose tissue well over the iris *V. cunnesius* differs from other members of the genus, except *V. engeli*, *V. georgii*, and *V. speigleri*. From *V. engeli* and *V. georgii* it differs in the position of the first dorsal fin origin and as a % of the pectoral length the pelvic fin is shorter in *V. cunnesius*. It has fewer scales

in the lateral series than has *V. spiegleri*. The specimens which Whitley (1941) attributed to *Mugil dussumieri* were stated to have a long pectoral fin and 'scales with crenulated membranous border'. These features do not occur in *L. dussumieri*, but are typical of *Valamugil*. Amongst the paratypes of *M. cunnesius* 2 jars have a third specimen which is not identical with those whose lengths are listed above, but are specimens of *L. parsta* A.3701 spec. 100mm, A.3702 spec. 102mm.

### *Valamugil engeli* (Bleeker, 1858a)

*Mugil engeli* Bleeker, 1858a: 385, Batavia, nomen nudum; 1859a: 277, Batavia; 1860c: 78, Sumatra; Günther, 1861b: 430, Java, Sumatra, Bali; Day, 1865: 139, Malabar; Weber & De Beaufort, 1922: 238, Pulaweh, Sumatra, Simular, Nias, Java, Bali; Fowler, 1928a: 122, Strong Is., Panapri; Pellegrin, 1933: 172, Madagascar; 1935: 72, Madagascar; Roxas, 1934, 404, pl. 1, fig. 1, Philippines; Herre, 1936b: 92, Papamoo Is., Tahiti; Schultz, 1943: 79, Apia, Tutuila, Swains Is.; John, 1955: 226, Kyamkulam L.  
*Chelon engeli* Schultz, 1953: 319, Bikini, Guam.  
*Valamugil engeli* Masuda et al, 1984: 120, pl. 347, fig. G, Japan.  
*Mugil kandavensis* Günther, 1877: 215, Kandavu; Herre, 1936b: 93, Nakalau, Fiji.  
*Mugil kelaartii* Fowler, 1900: 500, Panápe; 1903: 743, Hawaii; Steindachner, 1906: 1416, Upalu, Samoa, non Günther.  
*Liza caldwelli* Fowler, 1903: 747, Samoa, non Fowler 1900.  
*Mugil reebingeri* Steindachner, 1906: 1416, Samoa.  
*Liza labiosa* Fowler, 1918: 62, Philippines, non Valenciennes.  
*Agonostomus birarae* Duncker & Mohr, 1926: 134, fig. 9, Lieblieh Is., New Britain, S coast.  
*Myxus birarae* Fowler, 1928a: 127, New Britain; Lieblieh Is.

TYPE. Lectotype: RMNH 6392, Java, coll. Bleeker.

MATERIAL EXAMINED. Lectotype and 45 specimens, 17-220mm SL from E. Africa, Red Sea, India, Indonesia and the W Pacific. BMNH: 1858.4.2.104, 88mm, Amboina; 1858.4.21.19, 98mm, Borneo; 1863.10.12.10, 64mm, Ravuma R., Mozambique; 1874.11.14.15, 125mm, ?Sydney; 1877.4.18.1, 127mm, Rarotonga; 1877.4.18.4, 160mm, holotype of *M. kandavensis*, Kandavu, Fiji; pchsd Godeffroy Museum; 1882.2.25.82, 33mm, Tamatave, Madagascar; 1889.2.1.3676, 75mm, Malabar; 1890.2.26.122, 66mm, Tongatabu; 1905.12.1.7-10, 5 spec. 65-125mm, Tahiti; 1933.3.11.730, Sasugbu, Philippines; 1947.10.2.10-12, 3 spec. 75-76mm, Tonga; 1955.1.18.103-13, 11 spec. 52-138mm, Sabaki R., Kenya; 1960.3.15.1704-5, 60 & 62mm, Sudanese Red Sea. RMNH: 6392, 100mm, holotype of *M. engeli*, Java, coll. Bleeker. NHM: 67390, 95mm, holotype of *M. reebingeri*, Samoa, coll. Steindachner. ZIZM: H.155, 17mm, lectotype of *A. birarae*, New Britain, coll. 'Südsee Expedition'. H.154, 12mm, paratype of *A. birarae*, S coast New Britain, in fresh water, coll. 'Südsee Expedition'; H.157, 11mm, paratype of *A. birarae*, S coast New Britain, coll. 'Südsee Expedition'. AM: IA.5376, 87mm, Rarotonga; IA.5378-9, 93 & 111mm, Rarotonga; IB.3175, 110mm, Darwin. BPBM: 62-63, 71 & 124mm, Guam; 8434, 78 & 107mm, Tahiti. 12085, 4 spec. 124-135mm, Hiva Oa, Marquesas.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> 8, A III 9, P 15-16, LL 32-36, tr 11, ped. 7, pect. sc. 10-12, D<sub>1</sub> sc. 10-11, D<sub>2</sub> sc. 20-22. Scales with moderately long mucus grooves reaching inner margin of membranous edges. Body robust; head bluntly pointed, scale-free to posterior nostril; interorbital 1.5 times eye diameter or slightly more, slightly convex; eye diameter longer than snout; adipose tissue intruding on to iris, not quite to pupil, covering 2/3 of preorbital and posteriorly extending c.1/2 eye diameter. Upper lip almost vertical, only 1/5 eye diameter; single symphyseal knob, not projecting beyond lower lip; lip groove 1/5-1/4 lower lip length. Anterior mandibular pores large, at rear of symphyseal groove and about symphyseal knob breadth apart; another pair c.1.5 times as far apart and another 3 obscure pairs. Fine scattered ciliate teeth in both lips, tending to be lost in large fish; tongue slightly domed with low median ridge. Mouth corner on vertical from posterior nostril; tip of lower jaw reaching vertical from anterior rim of eye; fold of skin at mouth corner hiding pad over tendon to mouth corner in most specimens, just visible in some. Preorbital upper end reaching top of upper lip, above line joining midpoints of posterior and anterior nostrils; posterior nostrils not reaching above level of upper rim of eye; anterior nostrils wholly below vertical span of posterior nostrils. Gill rakers long, type 5.

Pectoral fin reaching vertical between mid-eye and anterior nostril when laid forward, to between bases of sp. 1 and sp. 2 of first dorsal fin and c.3/4 along pelvic fin (past tip of pelvic spine) when laid back; axillary scale reaching 3/4 along pelvic spine. Pelvic fin tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching c.3/4 along pelvic spine. First dorsal fin origin nearer caudal base than to snout tip; sp. 1 shorter than sp. 2; sp. 4 moderately long, reaching behind vertical from tip of sp. 3 when fin raised.; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin on vertical c. 1/3 along anal fin base; tips of anterior rays reaching past tips of posterior rays; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins densely scaled between clearly visible rays. Caudal fin lunate, Pyloric caeca 6.

DISTRIBUTION. Kenya, Red Sea, India, Indonesia, W Pacific to the Philippines, Tahiti and Guam.

REMARKS. Comparison of the types listed above shows them to be identical. Being in the juvenile querimana stage the type of *A. birarae* has different body proportions, but otherwise shows

all the typical features of *V. engelii*, except that the adipose eyelid is not developed at this size and there are only 2 anal spines. Although Fowler (1928) expressed the belief that the fish he identified in 1900 and 1903 as *M. kelaartii* were actually *M. trichilus* his descriptions do not bear this out but like Steindachner's (1906) description of *M. kelaartii* indicated that he had *V. engelii* before him. *Valamugil engelii* is distinguishable from *V. cunnesius* and *V. speigleri* by having the origin of the first dorsal fin nearer the caudal base than the snout tip; from *V. georgii* and *V. robustus* by the shallow caudal peduncle and the longer pectoral fins; and from all other species of the genus by their lack of adipose tissue over the eye.

#### *Valamugil georgii* (Ogilby, 1897)

*Mugil georgii* Ogilby, 1897b: 77, Georges R., NSW; Toshi, 1903: 7, pl. 2, fig. 1, Moreton Bay; Stead, 1908: 43, New South Wales; McCulloch, 1914: 326, New South Wales; 1921: 129, pl. 22, fig. 1, Port Hacking, Karuah R., Brisbane R.; Thomson, 1954: 94, pl. 1, fig. 2, Georges R., Port Hacking, Karuah R., Nerang R., Moreton Bay, Brisbane R., Breakfast Creek, Tweed R., Hawksbury R., Port Macquarie, Noosa R., Maroochy R., Burnett R., Marshall, 1964: 407, pl. 54, fig. 386, S Queensland.

*Valamugil georgii* Thomson, 1977, FAO Identification sheet.

*Mugil nortoni* Ogilby 1908: 22, Brisbane R.

HOLOTYPE. AM 14936, coll. Ogilby; type locality: Georges River.

MATERIAL EXAMINED. Holotype and 17 specimens, 68–254mm from central NSW to S Queensland. AM: 14936, 154mm, holotype of *M. georgii*, Georges R., coll. Ogilby; 1.12843–4, 88 & 118mm, Port Hacking; 1.12845, 254mm, Karuah R.; 1.14949–56, 8 spec. 88–118mm, Port Hacking. QM: 1775, 135mm, holotype of *M. nortoni*, Nerang R., coll. Ogilby; 1.1312–7, 4 spec. 153–166mm, Moreton Bay; 1.1697, 82mm, Breakfast Creek; 1.3109, 97mm, Indooroopilly, Brisbane R.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> 18, A III 9, P 16, L<sub>1</sub> 31–32, tr. 11, ped. 7, pect. sc. 10, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 22. Scales with moderately long mucus canals, not reaching membranous edge of scales; Y-shaped canals on some breast scales. Body robust, head bluntly pointed, scale-free to posterior nostrils; interorbital less than twice eye diameter, gently convex; eye diameter less than snout length. Adipose tissue covering most of iris. Upper lip median height 1/4 eye diameter. Symphysial knob not projecting beyond lower lip; lip groove 1/5 lower lip length. Large anterior mandibular pores at rear of symphysial groove, breadth of symphysial knob apart, another pair twice as far apart, behind, others obscure. A few scattered setiform teeth in upper lip, lower lip edentate. Tongue domed with high median ridge. Mouth corner on vertical from posterior nostrils;

tip of upper jaw below line of gape, reaching vertical from anterior rim of eye; small cutaneous flap at mouth corner partially obscuring pad over tendon to mouth corner. Preorbital upper end reaching 2/3 up upper lip and on line joining mid-points of posterior and anterior nostrils. Posterior nostril reaching above level of upper rim of eye, anterior nostril below vertical span of posterior nostril. Gill rakers long, type 5.

Pectoral fin reaching posterior nostril when laid forward, to vertical from base of sp. 1 of first dorsal fin and 3/4 along pelvic fin (not quite to tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from sp. 3 of first dorsal fin; axillary scale reaching 1/2 along pelvic spine. First dorsal fin origin markedly nearer caudal base than snout tip; sp. 1 shorter than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 2/3 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; Anal fin higher than second dorsal fin and both higher than first dorsal fin; second dorsal and anal fins densely scaled. Pyloric caeca 14.

DISTRIBUTION. E Australia (Port Hacking-Burnett River).

REMARKS. *V. georgii* differs from *V. engelii* in the lower scale counts, the deeper caudal peduncle and the shorter pectoral fins, it differs from *V. cunnesius* and *V. speigleri* in having the first dorsal fin origin nearer the caudal base than snout tip; and from all other members of the genus by the well-developed adipose tissue over the eye. McCulloch (1921) pointed out the synonymy of *M. nortoni* with his *M. georgii*.

#### *Valamugil robustus* (Günther, 1861b)

*Mugil robustus* Günther, 1861b: 432, Madagascar; Bleeker, 1874: 79, Madagascar; Sauvage, 1891: 39, pl. 41B, fig. 6, Madagascar; Boulenger, 1916: 92, fig. 54, Madagascar, Kosi Bay, Zululand; Barnard, 1925: 305, Zululand; Pellegrin, 1933: 176, Madagascar; Smith, 1935: 603, fig. 4, pl. 21, fig. A, Isipingo, Durban, Kosi Bay; 1948: 835, fig. 3, Durban to Delagoa; 1949: 318, fig. 878, Durban, Inhambane; Baissac, 1961: 150, Mauritius.

HOLOTYPE. BMNH 1972.11.27.2, Madagascar, coll. Grey.

MATERIAL EXAMINED. Holotype and 5 specimens, 124–214mm SL from Madagascar and Natal. BMNH: 1906.11.9.44, 214mm, Kosi Bay, Natal; 1920.3.2.22, 193mm, Herschall-Chauvin, Madagascar; 1972.11.27.2, 180mm holotype of *M. robustus*, Madagascar, coll. Grey. MNHN: A.3767, 153mm, Madagascar; A.3768, 124 & 145mm, Madagascar.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> 18, A III 9, P 16, L<sub>1</sub> 33–37, tr. 11, ped. 9, pect. sc. 8–10, D<sub>1</sub> sc. 10–11, D<sub>2</sub> sc. 22–23. Scales with long narrow mucus ca-

nals, not reaching inner edge of membranous margin; occasional anterodorsal scales with 2 canals. Body moderately robust, head bluntly pointed, scale-free to rear of posterior nostrils; interorbital less than twice eye diameter, gently convex; eye diameter longer than snout. Adipose tissue reaching over iris. Upper lip height  $>1/4$  eye diameter; lower lip recessed at symphysis, symphyseal knob projecting in front of lip; lip groove c.  $1/6$  lower lip length. Anterior mandibular pores large, twice symphyseal knob breadth apart; posterior pores obscure. Few scattered ciliate teeth in lower lip, upper lip edentate. Tongue domed with slight median ridge. Mouth corner at vertical from posterior nostril; tip of upper jaw just below line of gape, reaching vertical a little before the anterior eye rim; pad over tendon to mouth corner visible when mouth closed. Preorbital reaching  $2/3$  up upper lip, above line joining midpoints of posterior and anterior nostrils; posterior nostrils not reaching above level of upper eye rim; anterior nostrils wholly below vertical span of posterior nostrils. Gill rakers long, type 3.

Pectoral fin reaching posterior half of eye when laid forward, not quite to vertical from origin of pectoral fin and about  $1/2$  along pelvic fin (not to tip of pelvic spine) when laid back; pectoral axillary unusual in having a mucus canal. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale reaching past tip of pelvic spine in large specimens. First dorsal fin origin equidistant from caudal base and snout tip; sp. 1 longer than sp. 2, sp. 4 short, not reaching past vertical from sp. 3 tip when fin raised; axillary scale reaching  $3/4$  or more along membrane behind sp. 4. Second dorsal fin origin on vertical  $1/3$  along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal fin higher than second dorsal and both higher than first dorsal fin; second dorsal and anal fins fairly densely scaled. Caudal fin lunate. Pyloric caeca 6.

DISTRIBUTION. Natal and Madagascar.

REMARKS. This is the only species of the genus whose pectoral fin fails to reach the vertical from the first dorsal fin in adults, and whose dorsal fin origin is equidistant from snout tip and caudal base.

### *Valamugil seheli* (Forsskal, 1775)

*Mugil crenilabris seheli* Forsskal, 1775: 83, Red Sea.

*Mugil seheli* Valenciennes, 1836: 152(113), Red Sea (?misprint).

*Mugil seheli* Klunzinger, 1870: 827, Red Sea; 1884: 131, pl. 10, fig. 1, Red Sea; Day, 1876: 355, Red Sea, India, Malaya; 1889: 350, India; Boulenger, 1916: 91, fig. 63, Red Sea, Sey-

chelles, Zanzibar, Mombasa, Durban, Massawa; Weber & De Beaufort, 1922: 252, Singapore, Sumatra, Nias, Bunka, Java, Bali, Waigei, Nusa, Madura, Sumba, Celebes, Timor, Ambon, Halmahera, New Guinea; Barnard, 1925: 306, Natal; Fowler, 1925a: 209, Delagoa Bay; 1928a: 125, Guam, Apia, Shortland Is., Vavau, Tongatabu, Suva; 1932a: 444, Singapore; 1935: 143, Hong Kong; 1938b: 65, Nukahiva; 1939a: 47, Gulf of Thailand; Pellegrin, 1933: 175, fig. 95, Mauritius, Réunion, Seychelles, fresh water; Roxas, 1934: 417, pl. 1, fig. 10, Philippines; Smith, 1935: 621, fig. 11, pl. 16C, Durban; Peitschmann, 1939: 184, fig. 3, Red Sea; Schultz, 1943: 80, Apia; Pillay, 1962: 565, pl. 2, fig. 3, Port Blair, Andamans; Marshall, 1964: 410, col. pl. 55, Queensland.

*Liza seheli* Herre, 1932: 3, Tahiti; 1936b: 98, Nukahiva, Paepae, Maesques, Tahiti, Suva.

*Valamugil seheli* Smith, 1948: 842, Indo-Pacific; 1949: 323, fig. 889, Indo-Pacific to Durban; Thomson, 1954: 108, pl. 2, fig. 1, Cape York, Great Barrier Reef, Mindanao, Samoa, Bombay, Darwin, Princess Charlotte Bay; John, 1955: 228, Kyamkulam L.; Munro, 1955: 92, pl. 16, fig. 254, Ceylon; 1967: 170, pl. 18, fig. 287, New Guinea; Fourmanoir, 1957: 73, fig. 54, rivers of S Madagascar; Taylor, 1964: 120, Arnhem Land; Masuda et al., 1984: 120, pl. 105, fig. A, Japan.

*Mugil caeruleomaculatus* Lacépède, 1803: 385, no locality; Valenciennes, 1836: 128(95), Mauritius; Günther, 1861b: 445, Mauritius, Indonesia; Day, 1876: 356, Mauritius, Bombay, Andamans; 1889: 351, Seas of India; Sauvage, 1891: 398, pl. 43, fig. 2, Madagascar; Chaudhuri, 1917: 497, Chilka L.; Weber & De Beaufort, 1922: 250, Singapore, Sumatra, Java, Celebes, Pluiweh, Nias, Flores, Timor, Ambon, Ceram, Waigei, Oki Buru, Eiouw, Batu, Bintang, Cocos Is; Pellegrin, 1933: 174, Mauritius, Réunion, Seychelles, in fresh water; Roxas, 1934: 416, pl. 1, fig. 3, Philippines; Marshall, 1951: 6, pl. 3, fig. 2, Cape York; John, 1955: 228, Kyamkulam L.

*Mullus caeruleomaculatus* Shaw, 1804: 139, Indian seas.

*Mugil coeruleomaculatus* Bleeker, 1857b: 233, Batoc; 1857d: 479, Java; 1858b: 460, Cocos Is; 1859a: 279, Indonesian archipelago; 1860e: 5, Sumatra; 1861a: 65, Banka; 1874: 79, Madagascar.

*Liza caeruleomaculata* Jordan & Seale, 1906: 217, Apia; Seale, 1935: 355, Rennell Is., Pago Pago, San Cristobal.

*Liza caeruleomaculatus* Whitehouse, 1927: 93, Madras.

? *Mullus malabaricus* Shaw, 1804: 137, Indian Seas.

*Mugil axillaris* Valenciennes, 1836: 131(97), New Guinea, Indonesia, Mauritius; Bleeker, 1859a: 280, Cocos Is.; 1859d: 333, Java; 1860e: 3, Celebes; 1874: 79, Madagascar; Günther, 1861b: 444, Indonesia; 1877: 260, pl. 120, fig. 3, Samoa, Red Sea, Seychelles, East Indies; 1881: 216, Mauritius, New Guinea, Samoa, Red Sea, Seychelles, Indonesia; Kner, 1865: 227, pl. 9, fig. 3, Shanghai; Alleyne & Macleay, 1877: 341, Yule Is.; Macleay, 1882: 362, New Guinea; Sauvage, 1891: 397, pl. 43, fig. 1, 1a, Madagascar; Seale, 1901: 66, Guam.

*Mugil cylindricus* Valenciennes, 1836: 132(98), Batavia, Sumatra; Bleeker, 1853c: 266, Batavia, Sumatra; 1857a: 215, Nias; 1860d: 47, Borneo.

? *Mugil pederaki* Valenciennes, 1836: 137(102), Malabar, Coramandel; Bleeker, 1853b: 48, Bengal.

? *Mugil peradak* Bancroft, 1836: 132, Malabar & Coramandel.

*Mugil melancranus* Richardson, 1846: 246, Canton.

*Mugil borbonicus* Cantor, 1850: 1101, Malaya; Bleeker, 1859a: 279, Indonesia; 1859c: 375, Banka; 1861d: 75, Penang; 1874: 79, Madagascar; Sauvage, 1891: 397, pl. 43, fig. 3, Madagascar, non Valenciennes.



*Mugil parva* Bleeker, 1852b: 364, Batavia, Timor, 1852d: 445, Banka; 1852e: 701, Ceram; 1853b: 48, Bengal, non Hamilton Buchanan.  
*Mugil suppositus* Günther, 1861b: 437, Penang; Day, 1865a: 143, Malabar.  
*Mugil bleekeri* Günther, 1861b: 445, Banka, in rivers.  
*Mugil decemradiatus* Günther, 1861b: 452, Batavia, Timor.  
*Mugil delicatus* Alleyne & Macleay, 1877: 341, Cape York; Macleay, 1880: 122, Cape York; Whitley, 1932: 280, Great Barrier Reef.  
*Mugil delicatulus* Saville-Kent, 1889: 10, Great Barrier Reef; 1893: 370, Great Barrier Reef.  
*Mugil splendens* De Vis, 1884: 371, Cardwell.  
*Mugil (Liza) splendens* McCulloch & Whitley, 1925: 141, Queensland.  
*Liza splendens* McCulloch, 1929: 117, Cardwell.  
*Liza formosae* Oshima, 1922: 251, pl. 12, fig. 2, Taiwan; Matsumoto, 1955: 491, Taiwan.

TYPE. Neotype: BMNH 1969.2.8.2. (by present designation) Red Sea, coll. Jegge.

MATERIAL EXAMINED. 41 specimens, 38–385 mm SL, from E Africa, Gulf of Aqaba, India to Australia and Samoa. BMNH: 1860.3.19.361, 149 mm, holotype of *M. suppositus*, Penang, coll. Cantor; 1862.11.9.16, 240 mm, Natal R.; 1867.8.16.45, 332 mm, Seychelles; 1869.2.8.2, 124 mm, neotype of *M. seheli*, Red Sea, coll. Jegge; 1869.11.12.46, 245 mm, Kandavu; 1870.8.14.4, 122 mm, Burma; 1871.4.13.28, 155 mm, Massawah; 1871.7.15.9, 228 mm, Red Sea; 1875.10.5.45, 345 mm, Samoa; 1883.11.29.60, 66, 6 spec, 220–330 mm, locality unknown; 1884.4.5.28, 245 mm, Singapore; 1887.11.1.249, 242 mm, Muscat; 1894.8.3.33, 310 mm, Boraim R., Sarawak; 1911.8.23.10, 220 mm, Sarawak; 1933.3.11.733, 117 mm, Cebu; 1933.3.11.734, 38 mm, Bida, Philippines; 1934.2.22.55, 230 mm, Mauritius; 1945.11.29.645–51, 7 spec, 8–327 mm, Cocos-Keeling; 1951.1.16.621, Dalah, Gulf of Aqaba; MNHN: A.842, 131 mm, syntype of *M. axillaris*, Mauritius, coll. Desjardins; A.3622, 190 mm, syntype of *M. axillaris*, New Guinea, coll. Quoy & Gaimard; A.2618, 95 mm, holotype of *M. cylindricus*, Java, coll. Kuhl & Hasselt. AM: 1.11890–8, 9 spec, 250–320 mm, Cape York. QM: 113.967, 368 mm, holotype of *Mugil splendens*, Princess Charlotte Bay, Macleay Museum, Sydney; F.374–No.306, syntypes of *Mugil delicatus*, Cape York, coll. Alleyne & Macleay.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> 18, A III 9, (17) 18, L<sub>1</sub> 38–42, tr. 13, ped. 9, pect.sc. 11–12, D<sub>1</sub> sc. 11–13, D<sub>2</sub> sc. 23–26. Scales with finer fimbriations than other *Valamugil* spp., long mucus canals, irregular in direction, reaching inner edge of membranous margin; few scales with double or triple canals; secondary squamation dorsally. Body moderately robust; head bluntly pointed, scale-free to between posterior nostril and anterior rim of eye; interorbital > twice eye diameter, slightly convex; eye diameter longer than snout; adipose tissue rim round eye. Upper lip height 1/3 eye diameter; symphyseal knob projecting beyond lip edge; lip groove 1/5 lower lip length. Anterior mandibular pores at rear of symphyseal knob, breadth of symphyseal knob apart; other pores obscure. Well-spaced line ciliate teeth in both lips, shorter and sparser in the upper; tongue low-domed, without median ridge. Mouth corner on vertical from posterior nostril; tip of upper jaw below line of gape.

reaching vertical between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner hidden. Preorbital upper end almost to top of upper lip and above line joining midpoints of posterior and anterior nostrils; posterior nostrils reaching above level of upper rim of eye; anterior nostrils slightly overlap vertical span of posterior nostrils. Gill rakers long, type 4.

Pectoral fin reaching between anterior eye rim and posterior nostril when laid forward, to vertical from base of sp. 2 of first dorsal fin and c.2/3 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale not quite to tip of pelvic spine. First dorsal fin origin nearer snout tip than to caudal base, or equidistant; sp. 1 longer than sp. 2; sp. 4 strong, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching past membrane behind sp. 4. Second dorsal fin origin on vertical from anal fin origin; tips of anterior rays reaching behind tips of posterior rays; anal fin slightly higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins densely scaled. Caudal fin falcate. Pyloric caeca 7.

DISTRIBUTION. Indo-Pacific from Natal to Samoa and Taiwan.

REMARKS. Uncertainty regarding the type of *M. crenilabris seheli* (Klausewitz & Nielsen, 1965; Trewavas & Ingham, 1972) stems from no specimen remaining in Forsskal's collection labelled *seheli*; there is a specimen labelled *Mugil crenilabris* (f) *Tade* which has the characteristics usually attributed to *M. seheli* rather than those attributed to *Liza tade*. This circumstance suggests a mixing of labels, but there can be no certainty. To maintain current usage of *M. seheli* and *L. tade* there are 2 possible courses of action, other than maintaining the status quo: firstly to declare *M. crenilabris seheli* a nomen dubium, to recommend its suppression and hence recognition of *Valamugil caeruleomaculatus* as the valid name for the species; or secondly to select a neotype of *Mugil seheli*. Because the synonymy of *L. seheli* is so extensive and there is the possibility that some future worker may disagree with the fusion adopted here I propose the latter course and offer as neotype BMNH 1769.2.8.2, a specimen 124 mm SL, from the type locality, the Red Sea. Its principal biometric features are: depth 355 mm, HL 35 mm, head width 25 mm, interorbital 10 mm, eye diameter 9 mm; snout length 8 mm, mouth width 14 mm, pectoral fin length 32 mm, pelvic fin length 21 mm. It has 35 longitudinal

scales, 13 transverse and 9 down the caudal peduncle. The origin of the first dorsal fin is equidistant from the caudal base and snout tip.

Shaw's *Mullus malabaricus* and Valenciennes' *M. pedaraki*, both based on a figure in Russell (1803), by virtue of the falcate fins could be this species, but the description and figure are inadequate for certainty; it could be any species with falcate fins and 9 anal rays. Despite some variation in the comparative length of the pectoral fin, the type specimens of *M. axillaris* and *M. cylindricus* are identical and the same as the specimen which Valenciennes recognised as *M. caeruleomaculatus*. The type of *M. borbonicus* is *M. cephalus*, but as described by Bleeker (1858 etc) followed by Sauvage (1891) the name has been applied to specimens of *V. seheli* (Weber & De Beaufort, 1922).

Weber & de Beaufort (1922) distinguished *M. caeruleomaculatus* from *M. seheli* on the relative length of the pectoral fin, but this feature is variable within the species. Bleeker himself (1860c) placed the specimens he had identified earlier as *M. persia* in the synonymy of *M. axillaris* (= *M. seheli*). Günther (1861b) however thought Bleeker's *M. persia* to be a new species because of the erroneously reported 10 anal rays and named it *M. decemradiatus*. Günther (1861b) also named *M. bleekeri* for Bleeker's *M. borbonicus* which he rightly perceived was not identical with the species described by Valenciennes.

The types of *M. delicatus* and *M. splendidus* are identical with *V. seheli*. *Liza formosae* of Oshima (1922) is judged to be *V. seheli* on the basis of the published description. Fowler (1938b) recognised that his (1932b) identification of *M. thoburni* was erroneous. But if the specimens came from the Galapagos as he reported, then their identification as *V. seheli* is questionable as no other specimens have been reported so far east in the Pacific.

#### *Valamugil speigleri* (Bleeker, 1858a)

*Mugil speigleri* Bleeker, 1858a: 385, Batavia, nomen nudum; 1859a: 279, Indonesia; 1859f: 2, Borneo; 1860d: 58, Borneo; Günther, 1861b: 435, Java, Borneo, Hainan; Day, 1876: 346, Bombay; 1889: 342 pl. 74, fig. 1, Bombay; Chaudhuri, 1917: 498, Chikka L., Weber & De Beaufort, 1922: 241, Java, Borneo, Hainan; Barnard, 1925: 303, Delagoa Bay; Fowler, 1928a: 123, references; Pandey & Sandhu, 1992: 261, fig. 58, Bombay, India to Malay Archipelago.

*Valamugil speigleri* Thomson, 1974: FAO Identification Sheet, E Indian Ocean, W Pacific).

*Mugil tennesius* Cantor, 1850: 1083, Malaya; Günther, 1861b: 434, Red Sea, Amboina, Malaya, Indonesia; Klunzinger, 1870: 162, Red Sea; 1884: 131, Red Sea; Day

1865a: 136, Malabar; Pillay, 1962: (partim) 563, Bombay, Chikka L., non Valenciennes.

?*Mugil suppositus* Day, 1865a: 162, Malabar, non Günther.  
? *Myxus trimaculatus* Klunzinger, 1870: 832, Koseir, Red Sea.  
? *Agonostoma trimaculatum* Mohr, 1927: 179 fig. 2, Koseir.  
? *Mugil sordidus* Duncker & Mohr, 1926: 132, fig. 6, SW coast of New Britain, Admiralty Is., N coast in fresh water; New Guinea, E coast).

TYPE. Syntypes: RMNH 6395, Indonesia, coll. Bleeker.

MATERIAL EXAMINED. 12 syntypes and 16 other specimens, 62-158mm, from Pakistan, India, Malaya, Indonesia, Thailand and Australia. BMNH: 1860.3.19.359, 76mm, Malaya; 1860.3.19.364 5, 77 & 82mm, Malaya; 1889.2.1.3666, 4 spec. 142-149mm, labelled 'syntypes of *M. speigleri*, Indonesia', coll. Bleeker; 1889.2.1.3669, 120mm, Bombay; 1889.2.1.3670-3, 4 spec. 76-85mm, Madras; 1898.4.2.122, 114mm, Menam R., Thailand; 1898.6.29.169-70, 62 & 63mm, Karachi. RMNH: 6395, 12 spec. 90-143mm, syntypes of *M. speigleri*, Indonesia, coll. Bleeker. AM: A.18134, 134mm, Burdekin R., Queensland. ZFM: 11.158, 38mm, New Britain, below a waterfall, labelled 'lectotype *M. sordidus*', but without indication of who so designated it or when; F1.159, 32mm, New Britain, labelled 'paratype'; F1.160, 50mm, Liebliche Is., New Britain, labelled 'paratype'; F1.161, 3 spec. 33-34mm, Admiralty Is. and N coast Saba, labelled 'paratypes'; F1.162, 2 spec. 3.6 & 4.2mm, New Guinea, freshwater, labelled 'paratypes'.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 17, L<sub>1</sub> 37-40, tr. 11, ped. 7, pect. sc. 14-15, D<sub>1</sub> sc. 12-13, D<sub>2</sub> sc. 23-24. Scales narrow, mucous canals sometimes sinuous, not reaching edge of membranous margins; some anterodorsal scales with double canals. Body moderately robust, head bluntly pointed, scale-free to posterior nostrils; interorbital less than twice eye diameter, slightly convex, eye diameter longer than snout; adipose tissue extending over iris. Upper lip median height c. 1/5 eye diameter; lip groove 1/7 lower lip length; symphyseal knob not projecting from edge of lip. Anterior mandibular pores at rear of symphyseal groove, breadth of symphyseal knob apart; other pores obscure. Abundant fine ciliate teeth on lower lip; shorter, finer and sparser teeth on upper lip; tongue domed. Mouth corner on vertical between posterior nostril and anterior rim of eye; tip of upper jaw below line of gape, reaching vertical from anterior rim of eye; pad over tendon to mouth corner visible when mouth closed. Preorbital reaching almost to top of upper lip, above level of upper rim of eye; c. 1/3 anterior nostril overlapping vertical span of posterior nostril. Gill rakers long, type 5.

Pectoral fin reaching posterior nostril when laid forward, to vertical from base of sp. 2 of first dorsal fin and 3/4 along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching past tip of pelvic spine. First dorsal fin origin nearer snout tip than to caudal base: sp. 1 shorter than sp. 2; sp. 4 weak, not

TABLE 11. Biometrics of *Valamugil* spp (2). Abbreviations as in Tables 2-4.

Species	<i>V. robustus</i>	<i>V. seheli</i>	<i>V. speigleri</i>
Scale radii	10-15	10-15	10-15
Depth (%SL)	25.2-27.2	24.0-25.0	22.7-25.4
HL (%SL)	23.5-28.3	25.0-25.8	23.0-23.8
HW (%HL)	70.0-70.5	70.0-71.0	62.0-64.0
IO (%HL)	43.0-44.7	50.1-51.2	42.2-45.1
ED (%HL)	28.0-30.6	21.8-22.7	26.9-27.2
Snl. (%HL)	25.5-27.7	18.5-22.0	17.3-19.3
ULH (%HL)	5.5-5.8	6.0-6.5	4.8-5.7
MW/MH	1.3-2.5	2.0-3.0	1.7-2.2
PL (%HL)	70.2-72.5	83.5-96.5	85.0-90.0
PB (%PL)	8.7-13.3	9.5-12.8	9.0-14.0
PAX (%PL)	41.4-45.5	38.0-38.8	45.1-50.0
VL (%PL)	80.0-90.0	68.2-69.3	74.2-78.0
VAX (%VL)	67.0-74.0	66.6-69.0	45.0-50.0
FD (%FD)	25.0-30.0	35.0-47.0	45.0-50.0
HL/L	0	scattered	scattered
HL/L	scattered	scattered	scattered
LLS	8-12	0	0-5
FES	4	1-2	0
Sp.2/Sp.1	2.7	2.7	2.7
Sp.3/Sp.2	1.6	1	1
GR	22-30/34-40	20-45/49-73	20-29/34-45
IPC	6	7	4

reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching behind membrane behind sp 4. Second dorsal fin origin on vertical 1/4 along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins densely scaled. Pyloric caeca 4.

DISTRIBUTION, Pakistan to Indonesia and the NW coast of Australia.

REMARKS. *V. speigleri* is distinguished from other members of the genus, except *V. seheli*, by its high scale count; from *V. seheli* it can be distinguished by its adipose eyelids in the adult and at all stages by the fewer scales on the caudal peduncle. The high scale count and the adipose eyelids suggest that the species identified by Günther (1861b), Day (1865a) and Klunzinger (1870, 1884) as *Mugil cunnesius* may be this species. The description of *Mugil suppositus* by Day (1865a) could equally well apply to this species or to *V. seheli*, but as Day claimed that he could

distinguish it from that species, his *M. suppositus* may well have been *V. speigleri*. The types of *M. sordidus* are small and in a poor state of preservation, but they have characteristics, such as the long pectoral fin, which point to *M. speigleri*.

The description of *Myxus trimaculatus* by Klunzinger (1870) was inadequate for certain identification. The redescription by Mohr (1927) was little better other than to make it apparent that the specimen was in the juvenile querimana stage. The specimen can no longer be found, but the descriptions are consistent with *V. speigleri*.

### Crenimugil Schultz, 1946

*Crenimugil* Schultz, 1946: 387. Type species *Mugil crenulabris* Forsskal.

*Chebon* Oshima, 1922: 257. Type species *Mugil crenulabris* Forsskal (non Cuvier).

DIAGNOSIS. Mouth gape horizontal, mid-gape and mouth corner at level of lower half of pupil; mouth corner reaching vertical from anterior nostril; tip of upper jaw below line of gape, reaching vertical from posterior nostril or slightly behind. Upper lip developing papillae in fish > 60mm SL, in 1-10 rows, usually 5 or more; digitate folds or crenulations at mouth corners; lower lip folded down, its anterior edge sheathed in horny matter; symphyseal knob high, double; symphyseal groove deep; lip groove short; no fleshy lobes over ends of jaws or lying freely between rami of lower jaw. Maxilla mobile, tendon flange on central third of shaft at mouth corner level; below tendon flange maxilla curving in 2 planes to jaw end, but lacking outward twist typical of *Liza* spp., not visible above premaxilla or below mouth corner when mouth closed. Mandibular angle obtuse; lower jaw rami gently curving. Lips edentate, without teeth on vomer or palatines, but sometimes on pterygoids and tongue; tongue slightly domed, without median ridge. Adipose tissue rim around eye; interorbital almost flat. Preorbital notched, tending to fill with age. Nostrils variably positioned; posterior nostril reaching above level of upper rim of eye; anterior nostril reaching slightly below vertical span of posterior nostril in small fish, wholly within vertical span of posterior nostril in large fish.

Upper insertion of pectoral fin at level of upper rim of eye; axillary scale long and pointed; pelvic fin origin nearer vertical from pectoral fin origin than to that from origin of first dorsal fin. First dorsal fin origin nearer caudal base than to snout tip in small fish, tending to equidistance with age. Second dorsal fin origin variable relative to anal fin base, 3 anal spines in adults. Scale cycloid

with a broad flexible membranous margin. Head scale-free to posterior nostril. No spine on edge of operculum. Stomach with gizzard; pyloric caeca 7-8; intestine 5-7 times SL.

**REMARKS.** *Crenimugil* can be distinguished from most genera by the lip papillae; from *Oedalechilus* by the papillae being in multiple rows and by the crenulations of the mouth corner; from *Chelon* by the membranous edged scales, the elongate axillary scales and by the lower level of the mouth gape. The membranous edged scales and the long axillary scales indicate a close relationship with *Valamugil* though the curve of the maxilla shaft in 2 planes below the tendon flange is reminiscent of *Liza*.

Oshima (1922) listed only *Chelon crenilabris* in that genus and it is very different from the type species *Chelon chelo*.

#### KEY TO THE SPECIES OF *CRENIMUGIL*.

1. Fully developed papillae flask-shaped; second dorsal fin origin on vertical behind anal fin origin; 38-40 longitudinal scale rows (Indo-Pacific) . . . *crenilabris*  
Fully developed papillae widened laterally, horny crested; second dorsal fin origin on vertical 1/2 along anal fin base; 34-34 longitudinal scale rows (Indonesia and adjacent Pacific). . . . . *heterocheilus*

#### *Crenimugil crenilabris* (Forsskal, 1775)

- Mugil crenilabris* Forsskal, 1775: 17, Red Sea, Arabia; Bonaterre, 1780: 180, Red Sea; Bloch & Schneider, 1801: 115, Red Sea; Shaw, 1804: 136, fig. 115, Red Sea; Rüppell, 1835: 132, Red Sea; Valenciennes, 1836: 123(91), Red Sea; Günther, 1861b: 458, Red Sea; Klunzinger, 1870: 827, Red Sea; 1884: 133, pl. 10, fig. 2, Red Sea; Weber & De Beaufort, 1922: 256, Saonek; Norman, 1922: 319, Natal; Barnard, 1925: 307, Red Sea, Andamans, Nicobar; Fowler, 1927a: 10, Baker Is., Palmyra Is., Tongareva; 1928a: 126, Raiatea, Faté, Tahiti, Christmas Is., Guam, Jaulit, Makemo, Apia; 1935: 146, fig. 56, Macao; Fowler & Bean, 1927: 14, Sumatra, Java; Whitley, 1927: 11, Michaelmas Cay, Santo; Pellegrin, 1933: 179, Madagascar; Smith, 1935: 609, fig. 6, Durban; 1937: 172, Durban; 1949: 319, fig. 880, Indo-Pacific, south to Durban; Schultz, 1943: 80, Samoa, Canton Is., Taitia; Fourmanoir, 1957: 71, Nossi-bé, Marshall, 1964: 410, pl. 5b, fig. 394, Queensland; Randall, 1983: 94, fig., Red Sea; Masuda et al., 1984: 120, pl. 105, fig. D, Japan.
- Mugil crenilabris* Kner, 1865: 228, Nicobar; Day, 1876: 359, Nicobar, Andamans, Red Sea; 1889: 350, Seas of India; Günther, 1877: 219, pl. 122, fig. A, Kingsmill Is., Ponapé; Streets, 1878: 93, Hawaii; Roxas, 1934: 419, pl. 1, fig. 4, Philippines.
- Quarantius crenilabris* Seale, 1906: 15, Tahiti, Jordan, Snyder & Tanaka, 1913: 113, Japan.
- Liza crenilabris* Kendall & Goldsborough, 1911: 258, Guam, Makemo, Paumotu, Marshall Is.; Ferris, 1953: 230, Philippines.
- Chelon crenilabris* Oshima, 1922: 258, pl. 13, fig. 1, Pescadores.
- Crenimugil crenilabris* Schultz, 1946: 387, Christmas Is., Phoenix Is., Samoa, Tahiti, Marshall Is., Guam; 1953:

- 317, Guam, Bikini, Eniwetok; Smith, 1948: 636, fig. 5, Durban to Beira; 1949: 319, fig. 880, Indo-Pacific to Durban; Thomson, 1954: 117, fig. 13, Lord Howe Is., Santo (New Hebrides), Michaelmas Cay, Vanikoro Lagoon, Ellice Is., Purdy Archipelago, New Guinea; Matsubara 1955: 491, fig. 210, Pescadores; Fourmanoir, 1957: 71, fig. 52, Madagascar; Munro, 1967: 169, pl. 18, fig. 284, New Guinea; Shen, 1994: 438, pl. 137, fig. 7, Taiwan.
- Mugil cirrhostomus* Bloch & Schneider, 1801: 121, New Ireland, nomen nudum; Valenciennes, 1836: 127(94), fig. 312, New Ireland; Forster, 1844: 198, Tanna, Tahiti; Bleeker, 1860d: 47, Borneo.
- Mugil cirrhostoma* Günther, 1861b: 459, New Ireland.
- Oedalechilus cirrhostomus* Whitley, 1941: 19, Lord Howe Is.
- Mugil fasciatus* Valenciennes, 1836: 125(92), Red Sea.
- Mugil macrocheilus* Bleeker, 1854c: 43, Nova Selma; 1859a: 280, Cocos-Keeling; 1859a: 280, Indonesian archipelago.
- Mugil macrochilus* Günther, 1861b: 458, Java, Cocos-Keeling; Weber & De Beaufort, 1922: 257, Cocos Is.
- (?) *Mugil lauevergnii* Bleeker, 1860c: 4, Sumatra, non Eydon & Souleyet.
- Mugil nippellu* Günther, 1861b: 458, Red Sea.
- Mugil neocrenilabris* Castelnau, 1873a: 116, New Caledonia.
- Mugil crenipis* Roxas, 1934: 419, pl. 1, fig. 4, Philippines, non Castelnau.
- Mugil karlachi* Curtiss, 1938: 47, Tahiti.

**TYPE.** None. Type locality, Red Sea.

**MATERIAL EXAMINED.** 46 specimens, 27-264mm SL from E. Africa, Red Sea, Gulf of Aqaba, Laccadive and Maldive Islands, Cocos-Keeling, Christmas Is., Caroline Is., New Hebrides, New Guinea, Great Barrier Reef, Santa Cruz Is. BMNH: 1845.10.29.57, 240mm, holotype of *M. nippellu*, Red Sea, coll. Rüppell; 1871.7.15.8, 227mm, Red Sea; 1873.8.1.21, 258mm, Tahiti; 1879.5.22.65, 172mm, Ponapé, Caroline Is.; 1890.11.17.30-1, 168 & 179mm, Canton Is.; 1893.3.22.2, 57mm, Ancuta, Laccadive Islands; 1901.12.31.39, 62mm, Mladunadulu, Maldive Islands; 1902.11.15.84, 48mm, Mombasa; 1920.7.23.13, 147mm, St Lucia, Natal; 1927.2.10.77, 226mm, Russell Is., Great Barrier Reef; 1934.6.29.55-6, 60 & 75mm, Dolly Beach, Christmas Is.; 1949.11.29.640-4, 5 spec. 112-264mm, Cocos-Keeling; 1950.2.22.13-22, 10 spec. 27-36mm, Cocos-Keeling; 1951.1.16.622, 67mm, Dahab, Gulf of Aqaba; 1951.1.16.623-30, 8 spec. 99-108mm, Saniter Is., Red Sea. MNI IN: A 3624, 222mm, holotype of *M. cirrhostomus*, New Ireland, coll. Quoy & Gaimard; A.3639, 143mm, Red Sea; A.3657, 225mm, holotype of *M. fasciatus*, Red Sea, coll. Ehrenberg. AM: 14081, 76mm, Lord Howe Is.; 16574, 51mm, Santo, New Hebrides; 1A.2841, 87mm, Vanikoro; 1A.5826, 128mm, Ellice Is.; IB.3513, 130mm, Purdy Is.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 17, L I 38-40, tr 13-14, ped. 9, pect. sc. 10-13, D<sub>1</sub> sc. 11-13, D<sub>2</sub> sc. 23-26. Mucus canals long and narrow, reaching inner edge of marginal membrane of scales in some specimens; no multicanaliculate scales. Body robust, head bluntly pointed; interorbital less than twice eye diameter, almost flat; eye diameter greater than snout length. Upper lip median height c. 1/2 eye diameter, 1-10 rows of papillae on outer surface of lower 1/3 of lip (originating as simple mounds at about 7-8mm SL), becoming flask-shaped when fully developed with flaring, flattened distal ends; lower lip groove 1/5 of lower lip length; edge of lower lip

folded in shapes similar to papillae of upper lip, in large individuals with 1-4 rows of flask-shaped papillae inside folded edge, and 2 rows of less well-developed papillae below edge; series of crenulations at mouth corner, fimbriate in larger specimens; short folds along sides of symphyseal groove and occasional folds below lip edge in larger specimens. Anterior mandibular pores at rear of symphyseal groove, other pairs obscure. Teeth on pterygoids and tongue. Preorbital filling space lip to eye; serrae obscured by adipose tissue; upper end reaching c. 1/2 up upper lip, above line joining midpoints of posterior and anterior nostrils. Posterior nostril nearer eye than to anterior nostril; anterior nostril about equidistant from lip and posterior nostril. Gill rakers long, type 4.

Pectoral fin reaching mid-pupil when laid forward in small fish, to posterior nostril at about 110mm SL and to anterior nostril by 3220mm SL; reaching to vertical slightly in front of origin of first dorsal fin, c. 2/3 along pectoral fin (past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale reaching > 1/2 along pelvic spine. Sp. 1 of first dorsal fin shorter than sp. 2; sp. 4 slender, not reaching behind vertical from tip of sp. 3 when fin raised. Second dorsal fin origin on vertical slightly behind origin of anal fin; tips of anterior rays reaching well behind tips of posterior rays; anal fin and second dorsal fin subequal in height, higher than first dorsal fin; second dorsal and anal fins densely scaled. Pyloric caeca 7.

DISTRIBUTION. Indo-Pacific from Natal to Taiwan and Tahiti.

REMARKS. The type specimen is lost (Klausewitz & Nielsen, 1965), but it is generally accepted that the species recognised by recent authors as *C. crenilabis* is identical with Forsskal's species. Some authorities have recognised *M. macrocheilus* as a distinct species. The type specimen, 310mm long (Bleeker, 1854c), cannot be located. However, 2 specimens in the Rijksmuseum at Leiden labelled *M. macrocheilus* of 75 and 237mm SL are *C. crenilabis*. In the smaller specimen the papillae are just erupting and are still quite low in the larger specimen. The combined collections of the British, Paris and Leiden museums provide a good series displaying the development of the papillae. The fully developed papillae are well displayed by MNIN A.3624 which is the specimen named *M. cirrhostomus* by Valenciennes. It has 9 rows of flask-shaped papillae. The holotype of *M. fasciatus*

(MNIN A.3637) has 6 rows of papillae of which only those of the lowermost row have become flask-shaped. Preservation of the papillae is very poor in the majority of specimens studied, a condition not helped by the usual practice of placing a fish head down in the storage jar. The first use of *Mugil cirrhostomus* by Bloch & Schneider (1801) is a nomen nudum, the only indication being to an unpublished manuscript by Forster. Before Forster's (1844) publication appeared Valenciennes (1836) had published a description under this name. Although he attributed the species to Forster, Valenciennes appears to be the valid author of *Mugil cirrhostomus*, and A.3624 may be regarded as the holotype. It came from New Ireland, the type locality named by Bloch & Schneider and by Forster. Valenciennes erred in attributing to the specimen a longitudinal scale count of 30-35 and AIII 10; the specimen has 38 lateral scales and A.III 9. The nature of the developed papillae separates *C. crenilabis* from *C. heterocheilus*. In specimens without papillae or in the early stages of eruption, the lower scale count of *C. heterocheilus* and absence of crenulations or folds at the mouth corners, the site of origin of the second dorsal fin and the site of the posterior nostril all serve to differentiate the species.

### *Crenimugil heterocheilus* (Bleeker, 1855a)

- Mugil heterocheilus* Bleeker, 1855a: 198, Batjan; 1857b: 478, Java; 1859a: 280, Indonesia; 1867: 110, Batjan; Fowler, 1928a: 126, quoting.  
*Mugil heterocheilus* Bleeker, 1865c: 191, Ceram; Weber, 1913: 141, Amboin.  
*Mugil heterocheilus* Gunther, 1861b: 457, Java, Ceram, Celebes, Batjan; Weber, 1895: 268, Amboin; Weber & De Beaufort, 1922: 258, Java, Celebes, Batjan, Ceram, Amboin.  
*Crenimugil heterocheilus* Masuda et al, 1984: 120, pl. 105, fig. E, Japan.  
*Mugil papillosus* Macleay, 1884c: 270, fig., Normanby Is., freshwater; ? Tosh, 1903: 3, pl. 2, fig. 3, Moreton Bay.  
*Liza papillosa* Jordan & Seale, 1906: 218, Samoa.  
*Mugil (Liza) papillosus* McCulloch & Whitley, 1925: 111, Moreton Bay.  
*Oedalechilus papillosus* Whitley, 1941: 20, fig. 15, Normanby Is.  
*Crenimugil labiosus* Thomson, 1954: 119, fig. 11, Normanby Is.  
*Mugil bimaculatus* Seale, 1909: 501, pl. 5, Philippines; Roxas, 1934: 421, pl. 1, fig. 11, pl. 2, fig. 2, Philippines.

HOLOTYPE. RMNH 6408, Batjan, coll. Bleeker.

MATERIAL EXAMINED. Holotype, 4 paratypes and 15 other specimens, 75-245mm from the Moluccas, New Hebrides and Normanby Is. BMNH: 1890.4.21.166, 72mm, labelled 'paratype', coll. Bleeker, no locality; 1928.1.17.24-5, 223 & 242mm, Jordan R., New Hebrides. RMNH: 6408, 5 spec. 75-172mm, holotype and paratypes of *M. heterocheilus*, Batjan, Moluccas, coll. Bleeker. AM. I.13392-3, 145 & 187mm, syntypes of *M. papillosus*, Normanby Is., coll. Goldie.



DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P. 16, L1 34-38, tr. 13, ped. 9, pect. sc. 10-11, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 24. Long narrow mucus canals, not reaching the inner edge of membranous margins of scales, except on breast; some scales with double or treble canals. Body robust, head bluntly pointed, scale-free to posterior nostrils; interorbital less than twice eye diameter; snout length greater than eye diameter. Upper lip median height >1/2 eye diameter, 1-5 rows of papillae on outer surface of lower third of lip, originating as simple mounds at c. 70mm SL, becoming laterally extended with horny crests twice as wide laterally as vertically at mid-lip, relatively broader towards mouth corner; lower lip horny without folds or crenulations at the mouth corner; lip groove 1/10 of lower lip length. Anterior pair of mandibular pores at posterior end of symphyseal groove; 4 other pairs behind, along inner edge of jaw. No teeth on lips, tongue or palate. Preorbital filling space lip to eye, buried in adipose tissue, upper end reaching about 1/2 up upper lip and on line joining mid-points of posterior and anterior nostrils; nostrils nearer each other than to eye or lip; raised cutaneous rim around anterior. Gill rakers short, type 4.

Pectoral fin reaching anterior rim of eye when laid forward, not reaching vertical from origin of first dorsal fin, >1/2 along pelvic fin (not to end of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale not reaching tip of pelvic spine. Sp. 1 of first dorsal fin longer than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching about 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical c. 1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin higher than second dorsal fin, both distinctly higher than first dorsal fin; second dorsal and anal fins falcate, scaled anteriorly and along base. Pyloric caeca 8.

DISTRIBUTION. Indonesia to New Hebrides.

REMARKS. The basic anatomical features of the 2 species of *Crenimugil* are similar; the very different appearance of the mature papillae providing the most distinctive feature. Other differences have been mentioned in discussing *C. crenilabris*. Thomson (1954) assigned *M. papillosus* Macleay to *C. labiosus* (Valenciennes), but the several types show that *M. papillosus* is specifically identical with *C. heterocheilus* and that *M. labiosus* is generically distinct.

### Liza Jordan & Swain, 1884

- Liza* Jordan & Swain, 1884: 261, 264. Type species *Mugil capito* Cuvier, 1829.  
*Protomugil* Popov, 1930: 68. Type species *Mugil saliens* Risso, 1810.  
*Ellochelon* Whitley, 1930: 250. Type species *Mugil vaigiensis* Quoy & Gaimard, 1824.  
*Gracilimugil* Whitley, 1941: 19. Type species *Mugil ramsayi* Macleay, 1884b.  
*Moolgarda* Whitley, 1945: 14 (part). Type species *Moolgarda pura* Whitley, 1945.  
*Planiliza* Whitley, 1945: 17. Type species *Moolgarda ordensis* Whitley, 1945.  
*Heteromugil* Schultz, 1946: 394. Type species *Mugil tricuspidens* Smith, 1935.  
*Chelon* Schultz, 1946: 391, (part). Type species *Mugil chelon* Cuvier, 1829.  
*Pteromugil* Smith, 1948: 837. Type species *Mugil diadema* Gilchrist & Thompson, 1911.  
*Strializa* Smith, 1948: 837. Type species *Mugil canaliculatus* Smith, 1935.

DIAGNOSIS. Mouth gape horizontal or slightly oblique; mid-gape at level of mid-pupil or slightly above (except *L. saliens*) at level of lower rim of eye; mouth corner at level of lower quarter of eye, or just below, reaching distance specific to each species, but varying between vertical from anterior nostrils to vertical from anterior rim of eye; tip of upper jaw well above line of gape, reaching vertical from anterior rim of eye or just behind. Upper lip terminal, thin to moderately thick, of moderate height, without enlarged papillae or crenulations on outer surface; lower lip thin-edged, not permanently turned down; single high symphyseal knob; moderately deep symphyseal groove; no fleshy lobes over ends of jaws or lying freely between rami of lower jaws. Maxilla slightly mobile, tendon flange 1/2-2/3 down shaft, at or slightly above mouth corner; shaft of maxilla curving in 2 planes below tendon flange to an S-shaped lower end; not visible above premaxilla, but covering pad visible below mouth corner when mouth closed, smaller pad over the tendon to the mouth corner close behind. Edge of lower lips almost straight or very slightly curving; mandibular angle obtuse (except in young *L. richardsoni*; upper lip with labial teeth in 1-5 rows; lower lip edentate in most species; usually teeth on pterygoids and tongue, variably on vomer and palatines; tongue flat; domed or high-keeled. Adipose tissue variably developed from rim around eye to well over iris. Interorbital flat or slightly convex. Preorbital filling space lip to eye (except in *L. carinata* and *L. subviridis* only 3/4 filled); notched, tending to fill with age. Nostrils nearer each other than to lip or eye (rarely equidistant); posterior nostrils not reaching above level of upper rim of eye; anterior nostrils

TABLE 12. Biometrics of *Crenimugil* spp and *Liza* spp (1). \* Obsolete, # scattered between the 2 rows. Abbreviations as in Tables 2-4.

Species	<i>C. crenilabris</i>	<i>C. heterocheilus</i>	<i>L. abu</i>	<i>L. affinis</i>
Scale radii	5-8	5-6	6-8	6-7
Depth (%SL)	22.7-26.3	25.3-27.3	24.3-25.2	22.0-23.0
HL (%SL)	21.5-23.8	22.3-23.7	22.3-24.3	22.3-23.9
HW (%HL)	67.0-76.5	71.0-74.0	69.5-70.0	66.1-68.6
IO (%HL)	47.0-53.7	46.5-47.3	43.1-46.6	33.8-36.1
ED (%HL)	24.6-32.0	24.0-35.0	25.0-27.6	22.9-23.9
SnL (%HL)	22.8-25.5	26.1-30.2	20.6-23.3	21.6-22.2
ULH (%HL)	14.5-25.0	13.0-15.0	4.2-4.5	5.5-6.8
MW/ML	2.7-3.0	2.8-3.2	2.0-2.2	2.4-2.5
PL (%HL)	76.0-102.0	97.0-102.0	75.0-78.0	70.0-72.2
PB (%PL)	28.7-30.0	25.0-26.5	31.3-33.5	28.9-29.5
PAX (%PL)	33.0-39.0	31.3-36.6	Obs*	Obs*
VL (%PL)	70.2-80.5	73.0-76.0	75.0-75.9	84.7-92.3
VAX (%VL)	43.0-50.0	44.0-50.0	31.2-34.5	43.7-48.4
Ped. (%D)	46.5-50.0	42.0-53.3	45.8-48.3	54.4-56.1
TR(UL)	0	0	1	2+s#
TR(LL)	0	0	scattered	0
LES	14-17	40+	13-15	1-13
FES	17-20	0	8-11	0
Sp.2/Sp.1	3-3	5-0	3-3-5	2-0-3-3
Sp.3/Sp.2	1-3	1-4	1-2	1-3-1-5
GR	35-42 56-75	26-37 38-44	28-32 44-58	37-38 46-53
PC	7	8	4	6

wholly or partly within vertical span of posterior nostrils; slight cutaneous rim around anterior nostrils.

Upper insertion of pectoral fin at level of upper rim of eye; pectoral tip reaching well in front of origin of first dorsal fin (except in *L. parmata* and *L. abu*); axillary scale rudimentary (except in *L. affinis* where moderately developed). Origins of first dorsal and pelvic fins variably placed; second dorsal fin origin over anterior half of anal fin base (except in *L. tade*). 3 anal spines in adults; scales pavement ctenoid or cycloid. No spine on edge of operculum. Stomach with a gizzard; pyloric caeca usually 5, but up to 14; intestine length 4-6 times SL.

REMARKS. Pads over the lower end of the maxilla and over the tendon to the mouth differentiate this genus from all but *Chelon* and *Oedalechilus*; but *Liza* lacks the lip ornamentation of these genera. The pad in *Valamugil* is single, being that over the tendon to the mouth corner and even

there a cutaneous flap hides it in several species. All the types of the nominal genera listed in the synonymy of *Liza* have the typical exposed double pad and lack ornamentation on the lips. Each displays some anatomical specialisation, but the general mix of features is common to all species.

Apart from *L. dumerili* which he referred to *Heteromugil tricuspidens* Schultz (1946) included in *Chelon* all the species regarded here as belonging to *Liza*, as well as *Chelon chelo* (= *C. labrosus*), the type species of *Chelon*. The position of *Moolgarda* Whitley is complicated. No type specimen of *M. pura* was retained. Whitley's description refers to large pectoral axillary scales, the absence of papillae on the upper lip and an adipose eyelid 'not reaching the pupil', all of which are typical of *Valamugil*. But he went on to mention that some specimens lacked the axillary scale, had an exposed maxilla and exhibited 29-35 longitudinal scales compared with 36 in the type description. None of the specimens labelled '*Moolgarda pura*' in the Australian Museum have an axillary scale; all are *Liza subviridis*, referred to *L. dussumieri* in Thomson (1954). Whitley also described *Moolgarda (Planiliza) ordensis* whose types are *L. alata* Steindachner (referred in Thomson (1954) to *L. diademata* Gilchrist & Thompson). *Liza* is a large genus, with 22 species which display a wide range of variation without any consistent combination of features which might warrant generic distinction.

#### KEY TO THE SPECIES OF *LIZA*.

1. Teeth in upper lip tricuspid (South Africa)
  - ..... *tricuspidens*)
  - Teeth in upper lip not tricuspid . . . . . 2
- 2(1). Anal rays 11 (W Africa) . . . . . *falcipinnis*
- Anal rays fewer than 11 . . . . . 3
- 3(2). Anal rays 10 (S Australia)
  - ..... *argentea*
  - Anal rays 8 or 9 . . . . . 4
- 4(3). Anal rays 8 . . . . . 5
- Anal rays 9 . . . . . 8
- 5(4). 47-48 scales in longitudinal series; pectoral fin reaching vertical from first dorsal fin (Iraq, Iran, Syria, in fresh water). . . . . *abu*
- Fewer than 47 scales in longitudinal series; pectoral fin not reaching first dorsal fin . . . . . 6
- 6(5). About 30 scales in longitudinal series (S India)
  - ..... *mandapamensis* sp. nov.
  - 24-26 scales on longitudinal series . . . . . 7
- 7(6). Tail scarcely emarginate (Indo-Pacific)
  - ..... *luciae*
  - Tail forked (South Africa, E coast)
- 8(4). Pectoral fin reaching vertical from first dorsal fin origin; pelvic fin reaching behind first dorsal fin

- (Indian Ocean, Malaysia, Indonesia) . . . . . *parmata*
- Pectoral fin not reaching first dorsal fin; pelvic fin not reaching behind first dorsal fin . . . . . 9
- 9(8). Predorsal scales with 4 or more mucus canals . . . 10
- Predorsal scales with fewer than 4 mucus canals . . . 11
- 10(9). 34-36 scales in longitudinal series (S Africa) . . . . . *dumcristi*
- 43-48 scales in longitudinal series (Mediterranean) . . . . . *saliens*
- 11(9). Back keeled in front of dorsal fin . . . . . 12
- Back not keeled in front of dorsal fin . . . . . 13
- 12(11). Interdorsal space keeled (China sea) . . . . . *auratus*
- Interdorsal space not keeled (Red Sea to India; Egyptian Mediterranean) . . . . . *carinata*
- 13(11). Upper jaw reaching vertical behind anterior rim of eye; length to  $D_1 < 46\%$  SL (NE Asia) . . . . . *lauvergii*
- Upper jaw not reaching vertical behind anterior rim of eye; length to  $D_1 > 46\%$  SL . . . . . 14
- 14(13). Second dorsal fin origin on vertical from anal fin origin; pectoral fin  $< 70\%$  HL (South Africa) . . . . . *richardsoni*
- Second dorsal fin origin behind anal fin origin; pectoral fin  $> 70\%$  HL . . . . . 15
- 15(14). More than 40 scales in longitudinal series . . . 16
- Fewer than 40 scales in longitudinal series . . . . . 17
- 16(15). 9 scale rows down peduncle, pectoral fin laid forward reaching eye; posterior angle of preorbital pointed (Mediterranean; E Atlantic N of C. Verde) . . . . . *aurata*
- 11 scale rows down peduncle; pectoral fin laid forward not reaching eye; posterior angle of preorbital rounded (Mediterranean; E Atlantic N of C. Verde) . . . . . *ramada*
- 17(15). 13 scale rows in transverse series; pelvic fin reaching vertical behind sp. 4 of  $D_1$  (Indo-Pacific) . . . . . *macrolepis*
- Fewer than 13 transverse scales; pelvic fin not reaching vertical behind sp. 4 . . . . . 18
- 18(17).  $D_2$  origin on vertical  $> 1/2$  along anal fin base; head depressed, pointed (N Indian Ocean to W Pacific) . . . . . *tade*
- $D_2$  origin opposite anterior half of anal fin base; head not markedly depressed . . . . . 19
- 19(18). Snout  $< 20\%$  HL; preorbital not filling space lip to eye (N Indian Ocean to W Pacific) . . . . . *subviridis*
- Snout  $> 20\%$  HL; preorbital filling space lip to eye 20
- 20(19). Mouth corner at vertical from anterior nostril; unpaired fins falcate; pelvic fins  $> 91\%$  PL (Indo-Pacific) . . . . . *alata*
- Mouth corner at vertical from posterior nostril; unpaired fins not falcate; pelvic fin  $< 91\%$  PL . . 21
- 21(20). Pectoral fin  $> 80\%$  HL (W Africa) . . . . . *grandisquamis*
- Pectoral fin  $< 8\%$  PL . . . . . 22
- 22(21). 9-10 scales in transverse series; MW/ML ratio  $< 3$  (Indo-Pacific) . . . . . *melinoptera*

11 transverse scales; MW/ML ratio  $> 3$  (India and Pakistan) . . . . . *parsia*

### *Liza abu* (Heckel, 1846)

*Mugil abu* Heckel, 1846:244, pl.19, fig.2, Tigris R. to Mosul.

*Mugil (Liza) abu zarodnyi* Berg, 1949b: 852, fig. 73-5, Tigris R.; Svetidov, 1949: 867, rivers of Iran.

*Liza abu* Kurunuma & Abe, 1986: 209, Basrah Market.

?*Mugil pseudoteles* Pietschmann, 1912: 268, Schatt el Arab.

*Mugil (Liza) hisbni* Hora & Misra, 1943: 10, fig. 5, Rivers of Iraq.

TYPE. None. Type locality, Tigris R.

MATERIAL EXAMINED. 54 specimens, 27-177mm SL, from the Tigris and Euphrates rivers. BMNH: 1875.1.14.9-10, 112 & 126mm, Tigris R., Iraq; 1918.7.16.1-3, 3 spec. 46-48mm, Kurna, Iraq; 1920.3.3.277-86, 10 spec. 27-55mm, Basra, Iraq; 1938.6.8.2, 95mm, Baghdad, Iraq; 1968.12.13.443-45, 3 spec. 104-125mm, Euphrates R., Raqqa, Syria; 1968.12.13.446-51, 5 spec. 78-112mm, Tigris R., 25km from Mossul, Iraq; 1972.10.19.25-42, 18 spec. 37-43mm, Euphrates R., Ar Ramadi, Iraq.

DESCRIPTION.  $D_1$  IV,  $D_2$  i 8. A III 8-10, P. 16-17, L I 44-50, tr. 14-15, ped. 15, pect. sc. 10-11,  $D_1$  sc. 12-13,  $D_2$  sc. 29-30. Scales pavement ctenoid, mucus canals expanding posteriorly into an ovoid; occasional anterodorsal scales with double canals. Body moderately robust; head bluntly pointed, scale-free to just behind posterior nostrils; interorbital less than twice eye diameter, rather convex; eye diameter greater than snout length; adipose tissue intruding only slightly over iris. Upper lip height  $1/6$  eye diameter. Anterior mandibular pores at rear of symphyseal groove, rather more than breadth of symphyseal knob apart; 4 obvious pairs of mandibular pores behind. Single row of peg-like teeth in upper lip, scattered ciliate teeth in lower lip; vomer and palatines toothless, but teeth on pterygoids and tongue. Tongue high keeled, recessed at anterior tip. Mouth corner at vertical a little behind anterior nostril; tip of upper jaw reaching vertical from anterior rim of eye; maxilla shaft kinked c.  $1/3$  down, curving downward and outward below tendon flange; maxilla and tendon pads about equal length. Lower edge of preorbital almost horizontal, reaching  $1/2$  up upper lip, slightly above line joining midpoints of posterior and anterior nostrils; anterior nostril only slightly overlapping vertical span of posterior nostril; posterior nostril about equidistant from eye and anterior nostril; anterior nostril nearer posterior nostril than lip. Gill rakers short, type 4.

Pectoral fin reaching posterior half of eye when laid forward; not quite reaching vertical from origin of first dorsal fin and  $1/3$ - $1/2$  along pelvic fin (not to end of pelvic spine) when laid back. Pelvic fin origin nearer vertical from  $D_1$  origin than to

that from pectoral fin origin; axillary scale reaching c. 1/2 along pelvic spine. First dorsal fin origin nearer snout tip than caudal base; sp. 1 considerably longer than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2 along membrane behind sp. 4. Second dorsal fin origin on vertical c. 1/3 along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal fin not as high as first dorsal fin, but higher than second dorsal; second dorsal and anal fins lightly scaled anteriorly and along base. Caudal fin only shallowly forked. Pyloric caeca 4.

**DISTRIBUTION.** Freshwaters of Iran, Iraq and Syria.

**REMARKS.** This species displays a diversity of form and biometry unequalled elsewhere amongst the Mugilidae. In a single haul from Basra on the Euphrates, there were 14 specimens with 8 anal rays, 3 with 9 and 1 with 10. In this same group of specimens the longitudinal scale count was 44-50. Berg (1949b) named his subspecies on specimens which varied from Heckel's original description, but in view of the variability displayed in this single sample such a subspecific discrimination seems of doubtful validity. The high scale count, the pectoral fin almost reaching the vertical from the first dorsal fin origin and the unusual comparative length of the first dorsal fin together with the relatively stout spines in the first dorsal and anal fins, distinguish *L. abu* from other species in the genus. *Mugil pseudoteles* of Pietschmann (1912) may well have been this species, but is too slightly described for certainty.

#### *Liza affinis* (Günther, 1861b)

*Mugil affinis* Günther, 1861b: 433, fig., Amoy; Reeves, 1927: 8, Amoy, Wu, 1929: 81, fig. 64, Amoy; Fowler, 1935: 138, Amoy; Matsubara, 1955: 490, fig., Japan.

*Liza affinis* Shen, 1994: 438, pl. 137, fig. 8, Taiwan.

*Mugil carinatus* Oshima, 1919: 272, Taiwan; 1922: 247, Taiwan; 1926: 19, Taiwan; Wu, 1929: 79, fig. 63, Amoy, non Valenciennes).

*Afysus profugus* Mohr, 1927: 184, fig. 6, Japan & Taiwan.

*Myxus philippinus* Roxas, 1934: 424, pl. 2, fig. 1, Philippines.

**HOLOTYPE.** BMNH 1860.7.20.11, Amoy, purchased from Stevens.

**MATERIAL EXAMINED.** Holotype and 3 specimens, 151-210mm SL, from Fukien Province, China, and Taiwan. BMNH 1860.7.20.11, 150mm, holotype of *L. affinis*, Amoy; pchsd Stevens; 1862.12.6.12, 166mm, Taiwan; 1862.12.6.13, 167mm, Taiwan; 1936.10.7.48, 131mm, Sharp Peak, Fukien Province.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 16-17, L 38-40, tr. 11, ped. 9, pect. sc. 9, D<sub>1</sub> sc. 12, D<sub>2</sub> sc. 25. Scales pavement ctenoid, long mucous canals; no multicannaliculate scales; predorsal and inter-

dorsal scales in midline thickened and angled to form a median ridge. Body slender, head bluntly pointed, scale-free halfway to anterior nostrils; interorbital c. 1.5 times eye diameter, slightly convex; eye diameter longer than snout. Adipose tissue covering half iris. Upper lip median height c. 1/4 eye diameter. Anterior mandibular pores at rear of symphyseal groove, c. breadth of symphyseal knob apart; 4 other pairs behind. Lower lip edentate; row of unicuspid teeth on edge of upper lip, another row at base of lip, scattered teeth between; no teeth on vomer or palatines, but teeth on tongue and 3-4 rows on pterygoids. Tongue moderately keeled, recessed at anterior tip. Mouth corner at vertical from posterior rim of eye; pads over maxilla and tendon equal in size; preorbital not quite filling space lip to eye, reaching 3/4 up upper lip, on line joining midpoints of posterior and anterior nostrils. 50% of anterior nostril overlapping vertical span of posterior nostril; posterior nostril equidistant from anterior nostril and eye; anterior nostril nearer posterior nostril than to lip. Gill rakers short, type 3.

Pectoral fin reaching to posterior rim of eye when laid forward, only 1/5 along pelvic fin (not nearly to tip of pelvic spine) when laid back; axillary scale more like that of *Mugil* spp. than the rudimentary structure found in other *Liza* spp. Pelvic fin origin nearer vertical from first dorsal fin origin than to that from pectoral fin origin, its tip reaching vertical 1/2 along pelvic spine. First dorsal fin origin distinctly nearer snout tip than to caudal base; sp. 1 shorter than sp. 2; sp. 4 slender, but long, in some specimens reaching behind vertical from tip of sp. 4 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin on vertical from origin of anal fin or slightly behind; tips of anterior rays reaching behind tips of posterior rays in 1 of 4 specimen; anal fin c. same height as subequal dorsal fins; second dorsal and anal fins scaled anteriorly and along base. Caudal fin falcate. Pyloric caeca 6.

**DISTRIBUTION.** S China, Japan, Taiwan, Okinawa and the Philippines.

**REMARKS.** From their descriptions it is clear that the fish identified by Oshima (1919, 1922, 1926) and by Wu (1929) were *L. affinis*, not *L. carinata* which is recorded with certainty only from the Indian Ocean. *Afysus profugus* Mohr (1927) is the querimana stage of this species. The median dorsal keel distinguishes *L. affinis* from *Liza* except *L. carinata* in which the keel is lacking between the dorsal fins.

***Liza alata* (Steindachner, 1892)**

*Mugil alatus* Steindachner, 1892: 364, Madagascar, in fresh water.

*Liza alata* Shen, 1992: 438, pl. 137, fig. 9, Taiwan.

*Mugil diadema* Gilchrist & Thompson, 1911: 42, Natal; Barnard, 1925: 309, Port Elizabeth, Natal; Marshall, 1957: 132, Princess Charlotte Bay; 1964: 410, pl. 56, fig. 396, N Queensland.

*Pteromugil diadema* Smith, 1948: 837, fig. 6, Algoa Bay to Delagoa; 1949: 319, fig. 881, Port Elizabeth, Natal, Zululand; Fourmanoir, 1957: 74, Nossibé, Madagascar.

*Liza diadema* Thomson, 1954: 106, fig. 10, Melville Is., Ord R., Broome, Exmouth Gulf.

*Chelon diadema* Taylor, 1964: 119, Arnhem Land.

*Mugil compressus* Smith, 1935: 625, fig. 13, pl. 17, fig. B, Port Elizabeth, Natal, non Günther.

*Moolgarda (Planiliza) ordensis* Whitley, 1945: 17, fig. 9, Ord R.

TYPE. Lost. Type locality, Madagascar.

MATERIAL EXAMINED. 12 specimens, 115-460mm SL from Madagascar, N Australia and the West Pacific. BMNH: 1887.12.21.53, 460mm, E Madagascar. WAM: P.175, 240mm, Broome; P. 2487-8, 280 & 300mm, Exmouth Gulf; P.2758, 390mm, holotype of *M. ordensis*, Ord R.; Jenkins, AM: IA.5161, 155mm, Tonga; IA.5182, 115mm, Tonga; IA.7635, 189mm, Northern Territory; IA. 7638, 315mm, Ord. R.; IA.7654, 322mm, Ord R. BPBM: 12125, 148mm, Niva Ova, Marquesas.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 16-17, L1 29-31, tr. 11 ped. 7, pect. sc. 7-8, D<sub>1</sub> sc. 10, D<sub>2</sub> sc. 19-20. Body robust; head pointed, scale-free to anterior nostrils; interorbital slightly convex, less than twice eye diameter in small fishes, but greater in large; eye diameter less than snout length. Adipose tissue insignificant rim around eye. Upper lip height c.1/4 eye diameter. Anterior mandibular pores c. twice breadth of symphyseal knob apart; 3 other obvious pairs behind. 3-5 rows of unicuspid teeth in upper lip; lower edentate but with broad low papillae with long axes perpendicular to lip edge at inner base of lip; no teeth on palatine, but teeth on vomer, pterygoids and high-keeled tongue; mouth and tongue membranes with long pointed papillae. Mouth corner on vertical from anterior nostril; tip of upper jaw reaching vertical from posterior nostril. Pad over tendon as long as pad over maxilla but only 1/3 its width. Preorbital reaching 3/4 up upper lip, below line joining midpoints of posterior and anterior nostrils; anterior nostril entirely within vertical span of posterior nostril; posterior nostril nearer eye than anterior to lip. Gill rakers short, type 3.

Pectoral fin reaching anterior half of eye when laid forward, c.1/2 along pelvic fin (not to tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from first dorsal fin origin than to that from pectoral fin origin, its tip reaching vertical just behind sp. 3 of first dorsal fin; axillary scale reaching c.1/2 along pelvic spine. First dor-

TABLE 13. Biometrics of *Liza* spp (2). \* secondary radii. Abbreviations as in Tables 2-4.

Species	<i>L. alata</i>	<i>L. argentea</i>	<i>L. aurata</i>	<i>L. carinata</i>
Scale radii	4-8	7+6s*	10-12	6-7
Depth (%SL)	22.8-26.0	24.4-26.2	23.0-24.0	24.0-26.0
HL (%SL)	22.5-25.2	26.0-28.3	23.5-24.7	28.8-29.5
HW (%HL)	65.5-68.8	53.5-58.0	57.5-63.0	59.8-61.5
IO (%HL)	43.5-44.8	37.6-42.0	40.5-43.0	36.0-36.8
ED (%HL)	20.5-26.0	18.9-21.0	20.2-20.5	25.0-26.0
SnL (%HL)	21.0-26.4	20.5-22.0	24.5-25.0	19.4-21.1
ULH (%HL)	6.0-6.1	6.0-6.8	7.1-7.7	6.4-7.0
MW/ML	2.3	2.2-2.7	2.0-2.2	1.7-1.9
PL (%HL)	78.0-90.0	72.0-77.0	77.0-80.0	66.5-69.0
PB (%PL)	31.2-32.0	31.7-34.4	27.0-33.0	26.6-31.2
VL (%PL)	93.0-96.0	83.3-90.0	70.0-80.0	66.5-69.0
VAX (%VL)	36.0-38.0	24.0-31.7	49.0-56.0	43.0-55.0
Ped (%D)	45.0-45.5	50.0-54.0	40.0-47.0	46.5-46.6
TR(UL)	3-5	1	1	2
TR(LL)	0	1	0	0
LES	21-37	8-12	12-25	5-7
FES	20-25	15-24	11-15	8-9
Sp.2/Sp.1	4.0	3.7-4.6	2.6	3.0
Sp.3/Sp.2	1.7	1.2-1.6	1.5	1.4
GR	22-20/ 64-79	42-45/ 100-130	40-45/ 67-87	30-36/ 41-62
PC	5	2	8	5

sal fin origin nearer snout tip than to caudal base; sp. 1 shorter than sp. 2, sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical c.1/3 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal and second dorsal fins subequal, but first dorsal fin lower; second dorsal and anal fins falcate, densely scaled. Caudal fin falcate. Pyloric caeca 5.

DISTRIBUTION. Natal, Madagascar, N Australia, Tonga, Marquesas.

REMARKS. The very full description of *M. alata* given by Steindachner (1892) identifies his species with that named as *M. diadema* by Gilchrist & Thompson (1911). The compressed tail evidently led Smith (1935) to refer his specimens to *M. compressus* Günther. Specimens of *Moolgarda ordensis* identified by Whitley (1945) are identical with *L. alata*. The strongly falcate fins are more typical of *Valamugil* than *Liza* but in other characteristics, particularly in the mouth



structure, the weak axillary scales and the pavement ctenoid scalation, *L. alata* is a typical *Liza*. The falcate pelvic fins are almost as long as the pectoral fins and are inserted nearer the vertical from the origin of the first dorsal fin than to the pectoral fin origin, a condition shared within the genus only with *L. abu* and occasional specimens of *L. vaigiensis* and *L. richardsoni*. The fins of *L. vaigiensis* are far from falcate, and the high longitudinal scale count distinguishes *L. abu* and *L. richardsoni* from *L. alata*.

### *Liza argentea* (Quoy & Gaimard, 1824)

- Mugil argenteus* Quoy & Gaimard, 1824: 338, pl. 59, fig. 3, Port Jackson; Macleay, 1880: 417, Port Jackson, South Australia; Fitzroy R.; 1881: 47, Rockhampton; Waite, 1923: 107, fig., South Australia; Marshall, 1964: 411, pl. 56, fig. 397, sincerely, Qld.
- Mugil peronii* Valenciennes, 1836: 138(102), Westernport; Bleeker, 1855d: 12, NW Australia; Castelnau, 1873c: 151, Victoria; Macleay, 1880: 421, Westernport, Port Jackson; Ogilby, 1893: 120, pl. 32, NSW; Stead, 1906: 42, pl. 13, NSW; McCulloch, 1914: 142, NSW.
- Mugil ferrandi* Valenciennes, 1836: 142(105), Port Jackson; Bleeker, 1855d: 11, Port Jackson.
- Mugil australis* Steindachner, 1880: 6, Port Jackson.
- Mugil convexus* De Vis, 1884: 869, Cardwell.
- Mugil ramisayi* Macleay, 1884b: 208, Burdekin R.; 1885: 42, Burdekin R.; Marshall, 1964: 411, pl. 55, fig. 395, Burdekin R.
- Liza peronii*, Ogilby, 1887: 72, Tasmania.
- Mugil (Liza) argenteus* - McCulloch & Whitley, 1925: 141, Queensland.
- Liza argentea* - McCulloch, 1929: 116, sincerely Australia; Thomson, 1954: 100, fig. 7, Nepean R., Port Jackson, Brisbane R., Maroubra, Port Stephens, Melbourne, Myora, Clyde R., Mary R., L. Macquarie, Burnett R., Maroochy R., City Beach (WA); Scott, 1962: 137, fig., South Australia; Gomon et al., 1994: 661, sincerely Australia.
- Graulinigil ramisayi* - Whitley, 1941: 19, fig. 14, Burdekin R.
- Trachysoma ramisayi* Schultz, 1946: 392, Burdekin R.
- Liza ramisayi* Thomson, 1954: 106, fig. 9, Burdekin R.
- Mugil convexus* De Vis, 1884: 869, Cardwell.

TYPE. Syntypes: MNHN 4961 Port Jackson Quoy & Gaimard.

MATERIAL EXAMINED. 3 syntypes and 24 specimens, 74-261mm SL from Australia. BMNH: 1873.6.23.5, 188mm, Sydney; 1876.5.1.19-20, 201 & 231mm, Sydney; 1890.9.23.95-6, 197 & 213mm, Port Jackson; 1897.10.27.29, 142mm, Georges R.; 1914.8.20.262, 113mm, NSW. MNHN: 4961, 3 spec. 74-90mm, syntypes of *M. argenteus* and *M. ferrandi*, Port Jackson, coll. Quoy & Gaimard; A.3620, 142mm, holotype of *M. peronii*, 'New Holland', Peron. NHM: 68550, 170mm, holotype of *M. australis*, Port Jackson, Steindachner. AM: 1A.5944, 261mm, holotype of *M. ramisayi*, Burdekin R. Macleay; 1A.5945-6, 6 spec. 116-22mm, paratypes of *M. ramisayi*, Burdekin R.; 1.330, 145mm, Melbourne; 1.7619-50, 177 & 182mm, Port Jackson; 1.12606, 290mm, Brisbane R.; 1.12752, 223mm, Port Stephens; 1.15174 78mm, Wombeyn R.; 1.15182, 157mm, Nepean R. QM: 1.999, 161mm, holotype of *M. convexus*, Cardwell.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> I 8(9), A III, (9)10(11), P 16, L1 35-38, tr. 13-14, ped. 9, pec. sc. 10, D<sub>1</sub> sc. 13, D<sub>2</sub> sc. 23-24. Scales cycloid, laterally and antero-dorsally, pavement ctenoid dorsally behind second dorsal fin and on breast and belly; no flexible membranous margins; mucus canals short, bulbous; no multicanalicate scales. Body slender, head pointed, scale-free to posterior nostril; interorbital c. twice eye diameter, gently convex; eye diameter shorter than snout. Adipose tissue rim around eye. Upper lip median height c. 1.3 times eye diameter. Anterior pair of mandibular pores at rear of symphyseal groove, c. twice symphyseal knob breadth apart, a second obvious pair behind, others obscure. One row of teeth in each lip, fine and ciliate in lower, strongly curving in upper; 3 rows of papillae at inner base of lower lip; teeth on vomer, palatines, pterygoids and keeled tongue. Mouth corner on vertical between anterior and posterior nostrils; tip of upper jaw reaching vertical between posterior nostril and anterior rim of eye. Preorbital reaching c. 1/2 up upper lip, on line joining mid-points of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior nostril; anterior nostril nearer lip than posterior to eye. Gill rakers very long, type 6.

Pectoral fin reaching hind half of eye when laid forward, c. 1/2 along pelvic fin (not to tip of pelvic spine) when laid back. Pelvic fin origin distinctly nearer vertical from pectoral fin origin than to that from origin of first dorsal fin, its tip reaching vertical between bases of sp. 1 and sp. 3 of first dorsal fin; axillary scale reaching < 1/2 along pelvic spine. First dorsal fin origin nearer caudal base than to snout tip; sp. 1 shorter than sp. 2; sp. 4 strong, not quite reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/2 along anal fin base; tips of anterior rays reaching well behind tips of posterior rays. Anal fin considerably higher than subequal dorsal fins; second dorsal and anal fins densely scaled anteriorly and along base. Pyloric caeca 2.

DISTRIBUTION. S shores of Australia from Moore R. in Western Australia to Cardwell in Queensland.

REMARKS. The syntypes of *Mugil ferrandi* Valenciennes are the same specimens as the syntypes of *M. argenteus* Quoy & Gaimard. The holotype of *M. peronii* (MNHN A.3620) is about twice the length of the syntypes of *M. argenteus*, but similar in anatomical features. The paratype of *M. peronii* (MNHN 4965) is not the same species as the holotype; it has 12 anal rays and 56

scales in the longitudinal series, i.e., a specimen of *Aldrichetta forsteri*. The type of *M. australis* Steindachner is also identical in all features with *L. argentea*. *Mugil ramsayi* was named on a unique collection of 7 fishes from the Burdekin River in Queensland. 5 of these specimens have an anal fin count of 10, 1 has 9 and 1 has 11. Comparing them with typical *L. argentea* reveals no other distinguishing features. In some respects *L. argentea* is intermediate between typical *Liza* and *Mugil* or *Valamugil*. The tendon flange on the maxilla is higher than in other members of the genus. Teeth on the vomer and palatines and nature of the gill rakers is also more like a *Valamugil* or a *Mugil*. Nevertheless, *L. argentea* displays the exposed maxillary pad, lacks a pectoral axillary scale and has rows of papillae at the inner base of the lower lip, all features typical of *Liza*. The 10 anal rays distinguish *L. argentea* from all other members of the genus. Günther (1861b) attributed to *M. argentea* a fish which he recorded as having 9 anal rays, only 28 longitudinal scales and a well-developed adipose eye-lid, features not found in *L. argentea*. It was probably *L. subviridis*. Fowler (1931) recorded the species from Tonga, but he gave no description. In the absence of any other record from outside Australia, this must be regarded as a doubtful identification.

#### *Liza aurata* (Risso, 1810)

*Mugil auratus* Risso, 1810: 344, Nice; 1826, Mediterranean; Bonaparte, 1834: 31, figs 2-3 (part), Adriatic; Valenciennes, 1836: 43(31), fig. 308, Mediterranean; Lowe, 1843: 86, fig., Madeira; 1844: 394, Madeira; 1860: 163, fig., Madeira; Guichenot, 1850: 67, Algeria; Günther, 1861b: 442, fig., Lanzarote, England, Mediterranean; Steindachner, 1868: 682, Tenerife; Gervais & Boulart, 1877: 196, Mediterranean; Moreau, 1881: 185, fig. 167, France; Loret, 1883: 134, pl. 11, fig. 3 (part), Kertch, Sea of Azov; Smit, 1893: 373 fig. 89, Skaggerack; Sucker, 1895: 45, Adriatic; Boulenger, 1907: 435, pl. 81, Nile R.; 1916: 84, fig. 50 (part), L. Menzaleh, L. Borollus, Madeira, Porte Grande, Canary Is., Cape Verde Is., St. Louis, (Senegal); Antipa, 1909: 80, fig. 25, Black Sea; Ninni, 1909: 314, Adriatic; Pateschmann, 1912: 182 Gomera Is. (Canary Is.); Pellegrin, 1914: 31, Baie de Levrier, Senegal, Rufisque; Athanassopoulou, 1919: 268, figs 4, 6, 9, 21, 22, Mediterranean; Mohr, 1921: 11, North Sea; Chabanaud & Monod, 1927: 259, Baie de Levrier; Chevey, 1929: 339, fig., NE Atlantic; Nobre, 1935: 327, fig. 145, Portugal; Fowler, 1936: 589, fig. 269, Italy; Arné, 1938: 105, figs, Gulf of Gascony; Joulin, 1938: 339, fig., Mediterranean, Canary Is., British Is.; Lozano Rey, 1947: 728, fig. 188, San Sebastian, Malaga, Mar Menor, Melilla, Viera, Caxero (Morocco); Berg et al., 1949: 342, fig., England to Norway, Canary Is., NW Africa, Mediterranean, Black Sea, Sea of Azov; Nikolskii, 1954: 402, Black Sea, Sea of Azov; Morovic, 1957: 5, Adriatic; Soljan, 1963: 209, fig. 175, Adriatic; Bănărescu, 1964: 616, fig. 263-5, Italy; Svetovidov, 1964: 215, fig. 62-3, Black Sea; Bunn, 1968: 35, fig. 141c.

*Lizasmata* Popov, 1929: 245, Achakor, Kumach R., Nozin L., Burgas; 1930: 64, pl. 1, fig. 1, pl. 2, fig. 2, Black Sea; Cadenat, 1954: 575, Morocco, Port Etienne; Dieuzeide et al., 1955: 236, fig., Lakes of Tunis; Trowavus & Ingham, 1972: 17, fig. 1, Mediterranean, NE Atlantic; Tonopese, 1972: 30, Genoa, Camogli, Sestri Levante, Livorno, Venice, Naples, L. Patria, Dalmatia, Patresse, Vessilati, Tunisia; Bauchot & Pray, 1980: 301, fig. 27b, Morocco to Norway, Mediterranean.

*Mugil (Liza) aurata* Boicea, 1934: 267, figs. 9-13, Roumanian coast; Cabo, 1979: 192, fig. 60, Mar Menor.

*Liza auratus* Wheeler, 1969: 467, fig. 317, Mediterranean, Black Sea, Norway, British Is.

*Mugil cryptocheilus* Valenciennes, 1836: 61(44), R. Nile, Dumet, 1858: 263, Gorée.

*Mugil cryptocheilus* Günther, 1861b: 444, R. Nile.

*Mugil cryptocheilus* Rochebrune, 1882: 96, Senegambia.

*Mugil breviceps* Valenciennes, 1836: 106(78), Gorée; Dumet, 1858: 263, Senegal; Rochebrune, 1882: 96, Gorée.

*Mugil chelo* Lowe, 1839a: 184, Madeira, non Cuvier.

*Mugil madeirensis*, Lowe, 1839b: 182, Lanzarote, 1842: 8, Madeira.

*Mugil uctradatus* Günther, 1861a: 437, England.

TYPE. None. Type locality, Nice.

MATERIAL EXAMINED. 45 specimens, 125-440mm, from the Black Sea, Mediterranean, British Is., Cape Verde Is. and Madeira. BMNH: 1852.9.13.148, 384mm, L. Menzaleh; 1860.5.3.22, 234mm (labelled 'possible holotype of *M. madeirensis*'), Lanzarote pres. Lowe; 1861.3.9.45, 248 & 286mm, London market; 1862.1.15.19-20, 240 & 252mm, London market; 1864.2.5.112-4, 3 spec., 182-231mm, Black Sea; 1864.6.5.50, 146mm, Cape Verde Is.; 1888.2.3.64-5, 3 spec., 222-254mm, Lebanon; 1895.5.28.67, 425mm, Madeira; 1889.2.1.4690-5, 6 spec., 210-235mm, Cheltenham; 1905.2.28.4, 180mm, Penzance; 1907.3.14.2-3, 189 & 211mm, Stoke Gabriel, Totnes; 1907.3.14.2862, 227mm, L. Borollus; 1925.12.31.48, 191mm, L. Menzaleh; 1928.2.21.62-3, 126 & 148mm, Thrace; 1931.11.4.1-2, 204 & 250mm, Exmouth; 1935.3.5.57, 162mm, Haifa; 1937.7.22.1, 247mm, Moray Firth; 1955.9.16.2, 223mm, Langstone Harbour; 1957.9.11.1, 259mm, St Helier, Jersey; 1969.10.8.32-6, 5 spec., 188-225mm, Langstone Harbour; 1970.4.18.1-2, 201 & 229mm, Southsea Beach; 1970.12.1.3-5, 3 spec., 12-134mm, F. Thrace, MNHN: A.3665, holotype of *M. cryptocheilus*, R. Nile, Lefebvre; A.4677, 215mm, holotype of *M. breviceps*, Gorée, Senegal, Adamson.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III (8) 9, P. 17-18, L1 40-45, tr. 14-15, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 14-15, D<sub>2</sub> sc. 26-28. Scales pavement ctenoid, mucous canals moderately long, unusually wide on dorsal scales; interorbital c. twice eye diameter, slightly convex; eye diameter slightly shorter than snout. Adipose tissue rim around eye. Upper lip c. 1/3 eye diameter; lower lip folding at mouth corner to hide end of upper lip. Anterior mandibular pores immediately behind symphyseal groove, c. breadth of symphyseal knob apart, 1 less conspicuous pits behind. Sparse row of curving teeth in upper lip, lower lip edentate; minute teeth on vomer, none on palatines, present on pterygoid and domed tongue. Mouth corner on vertical from anterior nostril; tip of upper jaw reaching vertical from posterior nostril; pad over tendon to mouth corner only 1/2 length of pad.

over maxilla. Preorbital submerged in facial tissue, reaching 1/2 up upper lip, above line joining midpoints of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior nostril; anterior nostril nearer lip than posterior to eye. Gill rakers moderately long, type 4.

Pectoral fin reaching hind edge of eye in young fishes, to mid-pupil in older, when laid forward; >2/3 along pelvic fin (past tip of pelvic spine; when laid back. Pelvic fin origin nearer vertical from origin of pectoral fin than that from first dorsal fin origin, its tip reaching vertical from origin of first dorsal fin; axillary scale not reaching tip of pelvic spine. First dorsal fin origin slightly nearer snout than to caudal base; sp. 1 shorter than sp. 2; sp. 4 small, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2-2/3 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/3 along anal fin base; tips of anterior rays reaching as far back as tips of posterior rays in young fishes, not so far in older; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal fin and anal fin lightly scaled anteriorly and along base. Pyloric caeca 8.

**DISTRIBUTION.** Black Sea, Mediterranean, eastern Atlantic from Scotland to Cape Verde Islands. Introduced into the Caspian Sea c.1930 (Zenkevich, 1956).

**REMARKS.** The wide mucus grooves of the dorsal scales are characteristic of this species. *L. aurata* is one of the few members of the genus whose upper jaw end is at the level of the lower rim of the eye, the only one whose upper jaw reaches back only as far as the vertical from the posterior nostril. This species is often confused with *L. ramada* since their scale counts overlap and they are similar. The preorbital is a useful distinguishing feature, having a broad lower edge with a pointed posterior angle in *L. aurata* and a narrower end with a rounded angle in *L. ramada* (Trewavas & Ingham, 1972). *L. aurata* lacks teeth on the lower lip and the palatine, which are dentate in *L. ramada*. The type specimens of Risso no longer exist. Risso's (1810) description was inadequate for certain identification; he recognised 4 species and 2 varieties of mullet from western Europe and in 1826, regarded all 6 as good species. By elimination of recognisable species his *M. aurata* must be the species since accepted as bearing that name, following the descriptions of Cuvier (1829) and Valenciennes (1836). Dr E. Trewavas has examined Lortet's specimens. Two (Lyon 2919) have the character-

istics of *L. aurata*, but the others (Lyon 2923 and 2925) are young *L. ramada*.

### *Liza carinata* (Valenciennes, 1836)

*Mugil carinatus* Valenciennes, 1836: 148(110), Red Sea, Guam, Pondicherry, Malabar, Seychelles; Bleeker, 1853b: 48, Hindustan; Klunzinger, 1870: 831, Red Sea; Day, 1865: 145, Malabar; 1876: 349, Bombay, Red Sea; 1888b: 800, Bombay; 1889: 344, W coast of India; Sauvage, 1891: 397, pl. 42, fig. 1, Madagascar; Fowler, 1925b: 315, Bombay; Pellegrin, 1933: 177, Madagascar; Pillay, 1962: 548, Bombay, Sind, Karachi; Pandey & Sandhu, 1992: 264, fig. 60, Bombay, Red Sea to India.

*Liza carinata* Trewavas & Ingham, 1972: 24, Red Sea, Suez, L. Timsah, Kabrit, Port Said, Great Bitter Lake, Hammam Faroum, Bardwail.

*Liza carinata carinata* Masuda et al, 1984: 119, pl. 104, fig. 1, Japan.

*Mugil klunzingeri* Day, 1888a: 264, Bombay; 1889: 343, Indian seas.

**TYPE.** Lectotype: MNHN A.3643, (designated herein). Type locality, Red Sea.

**MATERIAL EXAMINED.** 34 specimens, 50-142mm from the Red Sea, Suez Canal, Mediterranean coasts of Egypt, India. BMNH: 1871.9.9.4, 7 spec, 54-70mm, L. Timsah, Suez Canal; 1889.2.1.3682, 88mm, Bombay; 1889.2.1.3683, 88mm, Sind; 1889.2.1.3767, 83mm, Sind; 1889.2.1.3779, 87mm, Sind; 1898.6.29.167-8, 91 & 109mm, Karachi; 1909.10.5.5-6, 37 & 48mm, Calcutta; 1925.9.19.92, 139mm, Kabrit, Egypt; 1928.11.30.7, 125mm, between Port Said and Darietta; 1929.8.31.6-9, 4 spec. 68-90mm, Port Said; 1929.8.31.10-12, 3 spec. 118-142mm, Great Bitter Lake; 1929.8.31.13-15, 3 spec. 100-119mm, L. Timsah; 1932.5.12.17-20, 4 spec. 122-131mm, W of Port Said; 1944.7.31.3, 75mm, Qatif Oasis, Saudi Arabia; 1951.6.20.1-2, 115 & 120mm, Hammam Faroum, Gulf of Suez. MNHN: A.3643, 80-88mm, lectotype and paralectotypes of *M. carinatus*, Red Sea, Ehrenberg; A.3619, 92mm, paralectotype of *M. carinatus*, Bombay, Dussumier; A.3631, 50 & 62mm, paralectotypes of *M. carinatus*, Pondicherry, Reynaud.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P. 17, LI 35-40, tr. 13, ped. 9, pect. sc. 8-9, D<sub>1</sub> sc. 11, D<sub>2</sub> sc. 21-22. Scales pavement ctenoid; moderately long mucus canals; double canals on some dorsal and fewer flank scales; predorsal scales in midline thickened and ridged to form a keel. Body robust, head bluntly pointed, head scale-free to rear of anterior nostrils in Red Sea fish, almost no scale-free area in Indian specimens. Upper lip height c.1/4 eye diameter. Anterior mandibular pores at rear of symphyial groove, c.breadth of symphyial knob apart; another large pair behind, others obscure. 2 rows of scattered teeth in upper lip, larger in outer row; lower lip edentate; no teeth on vomer or palatines, but teeth on pterygoids and slightly keeled tongue. Row of broad papillae at inner base of lower lip in Indian specimens; lacking in those from the Red Sea and the Mediterranean. Mouth corner at vertical from posterior nostril; tip of upper jaw reaching vertical from anterior rim of eye or slightly behind;

pad over tendon to mouth corner c. as broad as pad over maxilla, but  $3/4$  length. Preorbital reaching  $3/4$  up upper lip, on line joining midpoints of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior nostril; anterior nostril nearer lip than posterior nostril to eye. Gill rakers short, type 4.

Pectoral fin reaching posterior half of eye when laid forward, to vertical from base of sp. 1 of first dorsal fin in most or not quite reaching this vertical in some, to c.  $2/3$  along pelvic fin (variably not reaching or just reaching tip of pelvic spine) when laid back. Pelvic fin origin slightly nearer vertical from origin of pectoral fin than to that from first dorsal fin origin axillary scale not reaching tip of pelvic spine. First dorsal fin origin nearer snout tip than to caudal base; sp. 1 shorter than sp. 2; sp. 4 robust, not quite reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching  $3/4$  to length of membrane behind sp. 4. Second dorsal fin origin on vertical slightly before  $1/4$  along anal fin base; tips of anterior rays barely reaching as far as tips of posterior rays; anal fin slightly higher than subequal dorsal fins; second dorsal and anal fins lightly scaled anteriorly and along base. Pyloric caeca 5.

**DISTRIBUTION** Mediterranean coast of Egypt, Suez canal, Red Sea, Indian Ocean to Pakistan and India. The Mediterranean specimens are doubtless descendants of fish that made their way through the Suez Canal from the Red Sea.

**REMARKS.** Valenciennes (1836) recorded a specimen from Guam, collected by Quoy & Gaimard. This syntype MNHN A.3629 and 4 others, labelled as *M. carinatus*, from the Seychelles (A. 3820) are *Valamugil cunnesius*. In view of the confusion of 2 species amongst the syntypes it seems wise to designate a lectotype. The lectotype is 1 of 2 specimens in the jar MNHN A.3643. It measures 88mm SL, body depth 20mm and head length 25mm; scales in the longitudinal series 40. A specimen from this jar was selected because they were collected from the Red Sea and the section in which Valenciennes described the species is headed 'species from the Red Sea'. Klunzinger (1870) did not accept this species as coming from the Red Sea on the grounds that Ehrenberg's specimens came from Alexandria. Trewavas & Ingham (1972) have commented upon this matter. Ehrenberg collected both in the Red Sea and the Mediterranean, but this was before the Suez Canal was cut, whereas the restricted distribution along the Egyptian coast suggests a recent arrival through the canal as Tortonese (1953) has demonstrated for a number of species. However the specimens in Berlin are labelled,

the types in Paris, lodged by Ehrenberg, are labelled as from the Red Sea.

The keeled back readily distinguishes *L. carinata* from all other species of the genus except *L. affinis* in which the back between the dorsal fins is also keeled. Although identical in most respects the specimens from India exhibit constant differences from the Red Sea/Mediterranean fishes. They could be regarded as subspecies: *L. carinata carinata* (Valenciennes), scale count 35-40, inner edge of lower lip without papillae, head scale-free to anterior nostrils, scalation on second dorsal and anal fins denser than in *L. carinata klunzingeri*; and *L. carinata klunzingeri* (Day), scale count 32-35, inner edge of lower lip with a row of broad low papillae, scalation on second dorsal and anal fins relatively light.

### *Liza dumerili* (Steindachner, 1870)

- Mugil dumerili* Steindachner, 1870: 959, St Louis, Senegal.  
*Liza dumerili* Cadenat, 1954: 586, Senegal to Gabon; 1955: 60, Senegal to Gabon.  
*Mugil boefferi* Steindachner, 1882: 42, pl. 4, fig. 2, Gorée, Senegal; Pellegrin, 1914: 32, Baie de Lévrier; Boulenger, 1916: 98, fig. 57, Senegambia; Chabanaud & Monod, 1926: 260, Baie de Lévrier; Fowler, 1936: 590, Ashantee, Irvine, 1947: 199, fig. 117, Ghana.  
*Liza boefferi* Fowler, 1920: 252, Elimina, Ashantee; Cadenat: 1954: 586, Senegal to Gabon; 1955: 60, Senegal to Gabon; Boeseman, 1963: 13, R. Niger.  
*Mugil saliens* Rochebrune, 1882: 96, Senegambia; Fowler, 1920: 278, St Paul de Loanda, Angola; 1936: 588, (part), Angola; (?) Chabanaud & Monod, 1927: 254, Port Etienne, non Risso.  
*Liza abradus* Fowler, 1901: 746, pl. 45, fig. 1, Gabon R.  
*Mugil auratus* Boulenger, 1901: 353, R. Niger; 1916: 86 (part), Banana, East London; Barnard, 1925: 308 (part), East London, Natal coast; Pellegrin, 1933: 169, fig. 22, East London, Natal, non Risso.  
*Mugil candidulatus* Smith, 1935: 630, fig. 15, pl. 10, fig. B, Knysna, Port Alfred, Plettenberg Bay, Great Fish Point, East London, Maveppa Bay, Durban, Delagoa Bay.  
*Sivaliza candidulatus* Smith, 1948: 839, fig. 9, Mossel Bay to Delagoa Bay, Knysna, East London; 1949: 321, fig. 884, Cape Town to Delagoa Bay.

**HOLOTYPE.** NHM 60979, Dogara, Senegal, Vindabon.

**MATERIAL EXAMINED.** Holotype and 21 specimens, 94-227mm SL from the W coast of Africa and South Africa to Delagoa Bay. BMNH: 1899.11.27.49, 98mm, Banana, Congo; 1900.6.28.259-262, 4 spec. 110-296mm, St Louis, Senegal; 1905.1.7.5, 174mm, Swartkops R.; 1935.3.27.2, 178mm (labelled 'syntype of *M. candidulatus*', pres. Albany Museum), Knysna; 1949.12.6.98-99, 153 & 204mm, Lagos; 1956.9.6.32, 45mm, Tarkwe, Nigeria; 1969.1.29.13, 50mm, Lauanda. MNHN: C-298, 225mm, Mauretania; 1967-788, + spec. 102-124mm, Pointe Noire, Congo; A.4647, 194mm, Cape of good Hope, NAM; 60979, 115mm, holotype of *M. dumerili*, Dogara, Vindabon; 17750, 227mm, holotype of *M. boefferi*, Gorée, Mauritania. USNM: 42265, 138mm, St Paul de Loanda, Angola; 42266, 159mm, St Paul de Loanda; 42267, 135mm, St Paul de Loanda; 42268, 142mm, St Paul de Loanda.

TABLE 14. Biometrics of *Liza* spp (3). \* 1 row in young; adults edentate. # 9-10 in specimens 90-160mm SL; but the only large specimen available (400mm SL) had 40. Abbreviations as in Tables 2-4.

Species	<i>L. dumerili</i>	<i>L. falcipinnis</i>	<i>L. grandisquamis</i>	<i>L. kuivergnii</i>
Scale radii	5-8	7-8	7-9	6-8
Depth (%SL)	23.5-24.5	25.3-26.6	25.0-28.0	17.5-20.0
HL (%SL)	24.0-25.0	23.1-24.0	23.5-28.0	21.8-25.3
HW (%HL)	60.2-65.0	59.0-61.6	65.8-74.6	66.0-74.0
IO (%HL)	37.5-44.4	41.0-44.6	49.2-52.1	36.6-44.7
ED (%HL)	25.5-26.9	19.7-22.9	21.0-26.4	15.3-23.0
SnL (%HL)	25.0-26.2	19.7-22.9	21.0-26.4	15.3-23.0
ULH (%HL)	6.6-7.0	6.3-7.1	6.9-7.3	5.0-6.8
MW/ML	2.2-2.5	2.0-2.2	2.4-2.7	2.5-2.7
PL (%HL)	90.2-96.0	90.0-93.1	84.4-95.0	68.2-72.8
PB (%PL)	25.5-26.7	30.0-33.3	26.3-27.7	32.0-35.5
VL (%PL)	75.5-76.6	72.3-80.0	88.0-89.0	75.0-77.0
VAX (%VL)	42.5-53.5	44.7-51.8	38.5-46.8	43.2-45.5
Ped (%D)	47.5-51.8	42.6-48.4	48.1-55.0	51.0-57.0
TR(UL)	1-3	6-8	1-2	2
TR(LL)	0-1*	scattered	scattered	scattered
LES	10-20	14-19	9-10 (40)#	10-20
FES	1-7	18-22	14-17	16-21
Sp.2/Sp.1	2.1	2.5	3.2	3.0
Sp.3/Sp.2	1.5	1.4	1.25	1.8
GR	18-25/ 40-47	36-43/ 52-68	31-35/ 49-55	28-32/ 53-66
PC	6	8	6	6

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III (8)9 P 16(17), L1 34-39, tr. 12, ped. 8, pect. sc. 10-11, D<sub>1</sub> sc. 12-13, D<sub>2</sub> sc. 22-23. Scales pavement ctenoid, mucus canals moderately long, 5-8 on scales in front of dorsal fins, 2-4 on posterior dorsal scales, most flank scales with one canal, but some with 2 or 3. Body slender; head bluntly pointed, scale-free to anterior nostril; interorbital c. 1.5 times eye diameter, almost flat; eye diameter slightly longer than snout. Adipose tissue rim around eye. Upper lip height >1/4 eye diameter. Anterior mandibular pores at posterior end of symphyseal groove, somewhat more than symphyseal knob breadth apart; other pores obscure. 1-3 rows of sparse short straight teeth in upper lip; lower lip with ciliiform teeth in young fishes, edentate in older fishes. Teeth on vomer, palatine, pterygoids and tongue. Tongue with low median ridge. Mouth corner at vertical from anterior nostril; tip of upper jaw reaching vertical between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner c. 2/3 maxilla pad length. Preorbital

reaching 1/2 up upper lip, above line joining mid-points of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior nostril or in some specimens reaching just below; posterior nostril same distance from eye as anterior from lip. Gill rakers short to moderately long, type 4.

Pectoral fin reaching between eye and anterior nostril when turned forward, c. 1/2 length of pelvic fin (not reaching tip of pelvic spine) when laid back. Pelvic fin origin distinctly nearer vertical from origin of pectoral fin than to that from first dorsal fin origin, its tip reaching vertical from base of sp. 1 of first dorsal fin; axillary scale not reaching tip of pelvic spine. First dorsal fin origin equidistant from caudal base and snout tip; sp. 1 shorter than sp. 2, sp. 4 slight, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching to end of membrane behind sp. 4 in larger fish. Second dorsal fin origin opposite origin of anal fin; anterior rays reaching well behind tips of posterior rays; anal fin not as high as second dorsal fin, but both higher than first dorsal fin; second dorsal and anal fins somewhat falcate, lightly scaled anteriorly and along base. Pyloric caeca 6.

DISTRIBUTION. Coast of Africa from Senegal to Delagoa Bay.

REMARKS. The type of *M. hoefleri* is much larger than the type of *M. dumerili*, but no characteristic distinguishes them. BMNH 1935.3.27.2 labelled 'syntype of *Mugil canaliculatus*' and another specimen from the E coast of South Africa display no external characteristics differing from those of the W coast N of the Congo. The only other species of *Liza* with >4 mucus canals on the dorsal scales is *L. saliens*. Cadenat (1954, 1955) and Delais (1954, 1955) regarded *L. dumerili* as a subspecies of *S. saliens*. But *L. saliens* has 8 pyloric caeca instead of 6, has a much shallower pre-orbital notch and has a larger number of scales in both longitudinal and transverse series. 4 specimens from the Eclipse Expedition identified by Fowler as *Mugil saliens* are *Liza dumerili*.

#### *Liza falcipinnis* (Valenciennes, 1836)

*Mugil falcipinnis* Valenciennes, 1836: 105(77), Senegal; Dumeril, 1858: 263, Gorée; Günther, 1861b: 453, Senegal; Steindachner, 1870: 955, St Louis, Senegal; 1895: 35, Liberia; Rochebrune, 1882: 97, Gorée; Perugia, 1891: 969, Congo; Boulenger, 1901: 357, Congo R.; 1916: 88, fig., 51, St Louis, Senegal, Gambia, Nanna Kru, Liberia, Lagos, Nigeria R. delta, Old Calabar, Bernito R., Gabon, Chiloango, Luali R. Banana, Cabin, Angola; Pellegrin, 1913: 155, Banana; 1914: 31, Banana; Regan, 1915: 127,

Lagos; Fowler, 1936: 591, fig. 270, L. Ngovi (French Congo), Congo R., Ashantee; Irvine, 1947: 199, Ghana. *Liza falcipinnis* Fowler, 1919: 251, Elmina. Ashantee; Cadenat, 1954: 566; 1955: 60, Senegal to Congo, Ashantee, Guinea, Togo, Dahomey, Nigeria, Cameroon, Gabon; Poll, 1959: 263, fig. 90, Senegambia; Daget & Ittis, 1965: 212, fig. 132 Dahomey.

TYPES. Syntypes: MNHN A.3728 & A.3729, Senegal Jubelon & Rang.

MATERIAL EXAMINED. 3 syntypes and 58 specimens, 22-315mm SL from Senegal, Gambia, Sierra Leone, Liberia, Nigeria, Gabon and Congo. BMNH: 1862.11.22.4, 89mm, North Africa; 1863.2.13.17, 238mm, North Africa; 1865.3.5.19, 155mm, North Africa; 181.4.21.8, 77mm, Lagos; 1888.12.13.6, 190mm, Gabon; 1889.3.2.3, 179mm, Sette Cama, Gabon; 1895.7.18.17, 148mm, Wari, Old Calabar; 1895.7.18.43, 107mm, Old Calabar; 1899.2.20.9, 85mm, Banana; 1899.11.27.50-2, 3 spec. 118-198mm, Banana; 1900.6.28.253-8, 7 spec. 50-160mm, St Louis, Senegal; 1901.8.1.83, 232mm, Benito R., Congo; 1901.12.28.80-1 238 & 251mm, Gambia; 1909.7.16.33, 40mm, Niger R. delta; 1911.5.31.35, 167mm, Nanna Kru, Liberia; 1911.6.1.130, 183mm, Braza R. Angola; 1912.4.1.478, 201mm Chiloango, Congo; 1912.4.1.479, 156mm, Luali R., Congo; 1914.11.2.39, 58mm, Lagos; 1928.8.3.20, 236mm, Sierra Leone; 1932.2.27.18, 172mm, Accra; 1938.7.12.35, 199mm, Keta, Nigeria; 1945.10.2.20, 120mm, Lagos; 1949.10.20.135, 149mm, Ayensa R. Nigeria; 1949.10.20.136-8, 3 spec. 148-247mm, Lagos; 1949.12.6.100-3, 4 spec. 175-197mm, Gambia; 1953.4.28.275, 71mm Eljirin, Lagos; 1956.9.6.28-9, 141-148mm, Onikan, Lagos; 1958.9.18.269-78, 11 spec. 22-36mm, Bonthe, Sierra Leone; 1969.3.17.21-2, 68 & 82mm, Volta R. MNHN: A.3728, 236 & 296mm, syntypes *M. falcipinnis*, Senegal, A.3729 315mm syntype *M. falcipinnis*, Gorée.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 11, P 17, L1 35-37, tr. 13, ped. 7, pect. sc. 11-12, D<sub>1</sub> sc. 13-14, D<sub>2</sub> sc. 24-25. Ventral scales ctenoid; others cycloid with finely digitated membranous margin posteriorly; mucus canals long; some anterodorsal and flank scales with double canals. Body moderately robust; head pointed, scale-free halfway to anterior nostrils; interorbital less than twice eye diameter, slightly convex; eye diameter equal to snout length. Adipose tissue rim around eye. Upper lip height <1/3 eye diameter. Anterior mandibular pores at rear of symphyseal groove, c. breadth of symphyseal knob apart; obvious pair of pores behind, others obscure. 6-8 rows of teeth in upper lip, outer row unicuspid, others smaller and bicuspid; scattered ciliiform teeth in lower lip; no teeth on vomer or palatines, but present on pterygoids and tongue; tongue with low median ridge; mouth and tongue membranes with fine papillae. Mouth corner at vertical between anterior and posterior nostrils; tip of upper jaw reaching vertical between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner as large as, or larger than, pad over maxilla. Preorbital reaching 1/2 up upper lip, on line joining mid-points of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior

nostril; nostrils equidistant from each other and lip and eye. Gill rakers short, type 4.

Pectoral fin reaching between anterior rim of eye and posterior nostril when laid forward, to vertical from origin of first dorsal fin and between 1/2 and 3/4 along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral fin origin than to that from origin of first dorsal fin, its tip reaching to vertical between bases of sp. 1 and sp. 3 of first dorsal fin; axillary scale reaching c. 1/2 along pelvic spine. First dorsal fin origin equidistant from caudal base and snout tip; sp. 1 longer than sp. 2, sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised.; axillary scale reaching 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical c. 1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins falcate, lightly scaled anteriorly. Caudal fin lunate. Pyloric caeca 8.

DISTRIBUTION. W Africa from Senegal to the Congo.

REMARKS. Superficially *L. falcipinnis* has the appearance of a *Valamugil*, particularly in its falcate fins, membranous margin to the scales and the maxilla pad being hidden in some specimens. But the shape of the maxilla is typical of *Liza*, and the tendon flange is in the position of *Liza*, not of *Valamugil*. Also *L. falcipinnis* lacks the strong pectoral axillary scale typical of *Valamugil*. Although Daget & Ittis (1965) stated that this species has 15-18 pyloric caeca all specimens inspected in this study had 8. *L. falcipinnis* is immediately distinguishable within the genus by its 11 anal rays and membranous edging to the scales.

### *Liza grandisquamis* (Valenciennes, 1836)

*Mugil grandisquamis* Valenciennes, 1836: 103(76), Guinea, Gambia; Dumeril, 1858: 263, Senegal; Steindachner, 1870: 957, St Louis, Senegal; Peters, 1876a: 248, Cameroon R.; Pellegrin, 1914: 32, Senegal; Boulenger, 1916: 96, fig. 58, St Louis, Niger R.; Lohberger, 1929: 84, Senegal; Fowler, 1936: 593, Ashantee, Bathurst (Gambia); Irvine, 1947: 200, Gold Coast.

*Liza grandisquamis* Fowler, 1919: 253, Elmina, Ashantee; Cadenat, 1955: 60, Senegal to Congo, Mauretania; Poll, 1959: 266, fig. 91, Ashantee; Boeseman, 1963: 13, Niger R.; Daget & Ittis, 1965: 213, fig. 133, Dahomey.

*Mugil hypselopterus* Günther, 1861b: 450, fig., Niger R.; Rochebrune, 1882: 96, St Louis, Gambia, Falema.

?*Mugil compressus* Günther, 1861b: 451 ?Cape Verde Is; 1877: 217, pl. 123, fig. A, Ponape, Kanadavu.

*Mugil schlegelii* Bleeker, 1863a: 92, pl. 19, fig. 1, Ashantee; Rochebrune, 1882: 96, Casamanche; Osorio, 1894: 183, Bissau; 1898: 198 Bissau; Pellegrin, 1913: 153, Lagune de Grande, Bissau; 1914: 32, Lagune de Grande.

*Mugil productus* Fischer, 1885: 69, Eloly, Guinea.



**LECTOTYPE.** By present designation, MNHN A3743, Gorée, Senegal, Rang. The poor state of preservation of the paralectotypes make them practically useless for comparative purposes.

**MATERIAL EXAMINED.** Type and 17 specimens, including the types of *M. hypselopterus* and *M. compressus*, of 22-330mm SL from Senegal, Sierra Leone, Liberia and Nigeria. BMNH: 1847.4.4.7, 115mm, holotype of *M. hypselopterus*, Niger R., Fraser; 1861.11.7.1, 240mm, holotype of *M. compressus*? New South Wales; 1828.8.3.21, 216mm, Sierra Leone; 1949.12.6.80-84, 5 spec. 100-440mm, Lagos; 1949.12.6.104, 2mm, Ladeba, Lagos Lagoon; 1956.9.6.50-1, 104 and 106mm, Onikan, Lagos; 1963.3.6.10, 110mm, Gambia R., 60 miles upstream; 1968.11.15.87-9, 3 spec. 129-145mm, Lagos; 1971.8.13.23, Sannu, Freetown, Sierra Leone. MNHN: A.3743, 197mm, lectotype of *M. grandisquamis*, Gorée, Senegal, Rang; A.3744, 275mm, paralectotype of *M. grandisquamis*, Senegal, Roger; A.3745, 330mm, paralectotype of *M. grandisquamis*, Senegal, Heudelot.

**DESCRIPTION.** D14, D2 18, A 11 9, P (15) 16 (17), 1.125-29, tr. 9-10, ped. 7, pect. sc. 8-9, D1 sc. 10, D2 sc. 17-18. Scales pavement ctenoid, mucus canals long, some scales with double canals, particularly in front of the first dorsal fin, but also on flanks. Body robust; head bluntly pointed, scale-free halfway to anterior nostrils; interorbital more than twice eye diameter, almost flat; eye diameter longer than snout in small fishes, equal in large. Adipose tissue rim around eye. Upper lip height  $>1/3$  eye diameter. Anterior pair of mandibular pores at posterior end of symphyseal groove, slightly more than symphyseal knob breadth apart; obvious pair of pores behind, others obscure, 1-2 rows of scattered short teeth in upper lip, usually not apparent in fish  $<10$ mm SL; few sparse ciliiform teeth in lower lip, or none; no teeth on vomer or palatines, but present on pterygoids and tongue; tongue sharply keeled in young, becoming dome-shaped with a median ridge and completely dome-shaped as size increases; wide closely-set papillae in row at inner base of lower lip, tending to fuse into a more or less continuous ridge in large fish. Flattened papillae on mouth membrane. Mouth corner at vertical from posterior nostril; tip of upper jaw reaching vertical from anterior rim of eye in fish  $<120$ mm but reaching vertical in front of eye in larger fish. Pad over tendon to mouth corner c.  $1/2$  length of maxilla pad. Preorbital reaching  $3/4$  up upper lip, above line joining posterior and anterior nostrils; c. 50% of anterior nostril below vertical span of posterior nostril; posterior nostril nearer eye than anterior to lip. Gill rakers moderately long, type 3.

Pectoral fin reaching to between mid-eye and posterior nostril when laid forward,  $>1/2$  along pelvic fin (reaching behind tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical

from pectoral fin origin than to that from first dorsal fin origin, its tip reaching vertical between bases of sp. 2 and sp. 3 of first dorsal fin; axillary scale reaching c.  $1/2$  along pelvic spine. First dorsal fin origin nearer caudal base than snout tip or equidistant; sp. 1 longer than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching  $1/2$ - $2/3$  along membrane behind sp. 4. Second dorsal fin origin on vertical  $1/3$ - $1/2$  along anal fin base; tips of anterior rays reaching well behind tips of posterior rays; anal fin slightly higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins falcate, scaled anteriorly and along base. Caudal fin lunate. Pyloric caeca 6.

**DISTRIBUTION.** Western Africa from Senegal to Nigeria.

**REMARKS.** The specimen MNHN A 3743 is nominated as lectotype as it was the only syntype in good condition when inspected. It is 197mm SL, body depth 46mm and head length 49mm; it conforms with the description given above. The holotype of *M. hypselopterus* displays no differences from *L. grandisquamis*. Although Fischer (1885) described his specimen as having 10 anal rays, the type has 9. I accept Boeseman's (1963) opinion that the holotype of *M. schlegelei* Bleeker is a specimen of *L. grandisquamis*. The holotype of *M. compressus* Günther is also a specimen of *L. grandisquamis*. Its locality is given as 'New South Wales', a locality record which must be in error, but it should be noted that subsequently Günther (1877, 1881) recorded *M. compressus* from other South Pacific localities. According to Daget & Itis (1965) the number of pyloric caeca varies between 5 and 10, but all specimens examined in this study had 6.

The longitudinal scale counts of only 5 other species of *Liza* overlap with that of *L. grandisquamis*. Of these *L. alata* and *L. subviridis* differ in having 11 transverse rows of scales, in having the origin of the first dorsal fin nearer the snout tip than the caudal base, and having fewer than 6 pyloric caeca. *L. luciae* differs in having 8 anal rays and only 14 pectoral rays. *L. vaigensis* also has 8 anal rays and has only 8 transverse rows of scales. *L. melinoptera* is very similar to *L. grandisquamis*, but like the other species contrasted above it is an Indo-Pacific species, not overlapping the range of *L. grandisquamis* in W Africa. It has relatively short pectoral fins with only 15 pectoral rays, compared with the normal 16 in *L. grandisquamis*, and its gill rakers are more numerous and of type-4 rather than type 3.

***Liza lauvergnii* (Eydoux & Souleyet, 1841)**

*Mugil lauvergnii* Eydoux & Souleyet, 1841: 174, pl. 4, fig. 3, Macao.

*Mugil haematocheilus* Schlegel, 1845: 167, Nagasaki; 1845: 135, pl. 72, fig. 2, Nagasaki; Bleeker, 1854a: 107, Japan; Günther, 1861b: 422, China & Japan; Peters, 1880: 923, Ningpo; Steindachner & Döderlein, 1887: 266, Tokyo; Schmidt, 1904: 61, Sea of Japan; Tanaka, 1911: 137, fig., Japan; Jacor, 1930: 825, Japan; Sowerby, 1930: 157, Tientsin, Peking; Fowlet, 1935: 144, China seas; Taranetz, 1937: 85, Sea of Japan; Boeseman, 1947: 116, fig., Japan; Okada, 1952: 120, Japan.

*Liza haematocheila* Jordan & Metz, 1913: 26, Korea; Jordan, Snyder & Tanaka, 1913: 113, Japan; Jordan & Hubbs, 1925: 208, Japan; Popov, 1929: 247, Sea of Japan, Peter the Great Bay, Vladivostok; Matsubara, 1955: 491, Sea of Japan, Ryuku Is; Kamohara, 1958: 12, fig., Kagoshima; Chying, 1961: 326, pl. 119, fig. 581, Korea; Masuda et al. 1984: 119, pl. 104, fig. H, Japan.

*Mugil xanthurus* Richardson, 1846: 248, Canton.

*Mugil so-mi* Basilevsky, 1855: 226, pl. 4, fig. 3, Peking; Günther, 1873: 243, China; 1898: 260, Newchong; Morrison, 1898: 265, Liao; Taranetz, 1937: 85, Sea of Japan; Berg et al. 1949: 540, fig., Sea of Japan, Amur R., Fuson, Yellow Sea to Tientsin; Nikolaïkii, 1954: 402, Sea of Japan & Yellow Sea.

*Mugil sinensis* Bleeker, 1873: 143, China.

*Agonostoma plicatile* Bleeker, 1873: 143, Peking.

*Mugil joyneri* Günther, 1878: 486, Tokei, Japan; 1880b: 68, Japan.

*Liza menada* Tanaka, 1916: 394, Japan; Jordan & Hubbs, 1925: 208, Japan; Ishikawa, 1931: pl. 22, fig. 2, Japan.

*Liza borealis* Popov, 1930: 80, pl. 2, fig. 1, pl. 4, fig. 1, Vladivostok; Soldatov & Lindberg, 1930: 575, Vladivostok.

TYPE. Holotype: MNHN 8138, Macao, Eydoux & Souleyet.

MATERIAL EXAMINED. Holotype and 23 specimens, including the types of *M. joyneri* and *M. haematocheilus*, 53–466 mm from China, Taiwan and Japan. BMNH: 1851.12.27.112–3, 142 & 153 mm, China; 1855.9.19.763, 155 mm, locality unknown; 1862.12.6.10–11, 188 & 200 mm, S Taiwan; 1873.9.23.14–15, 102 & 103 mm, Chefoo; 1973.9.23.16, 129 mm, Chefoo; 1878.4.5.90–1, 98 & 111 mm, syntypes of *M. joyneri*, Tokei; 1905.6.7.7, 238 mm, Inland Sea; 1920.3.7.24–5, 61 & 69 mm, Foulkien; 1923.2.26.248, 182 mm, Port Arthur; 1923.2.26.254–5, 330 & 383 mm, Tokyo. MNHN: 8138, 180 mm, holotype of *M. lauvergnii*, Macao; Eydoux & Souleyet; 7492, 165 mm, China; 41–130, 53 mm, Tou-tchiou; 91–626, 466 mm, Shanghai; RMNH: 1160, 145 mm, lectotype of *M. haematocheilus*, Nagasaki; Schlegel; 1157–59, 3 spec. 128–202 mm, paralectotypes of *M. haematocheilus*, Nagasaki, Schlegel.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> 8, A III 9, P 18, L I 41–42, tr. 14, ped. 11, pect. sc. 8–9, D<sub>1</sub> sc. 11, D<sub>2</sub> sc. 25–26. Scales pavement ctenoid, mucus canals moderately long; no multicanalliculate scales. Body elongate, slender; head pointed, scale-free to just before anterior nostrils; interorbital less than twice eye diameter in small fish but more than twice in larger fish; eye diameter subequal to snout length. Adipose tissue covering 1/3 of iris. Upper lip median height > 1/3 eye diameter. Anterior mandibular pores at rear of symphyseal groove, width of symphyseal knob apart:

two other obvious pairs behind, others obscure. 2 rows of fine unicuspid teeth at edge and inner base of upper lip; few scattered ciliiform teeth in lower lip; no teeth on vomer or palatine, but teeth on pterygoid and moderately keeled tongue; mouth membrane with fine trid papillae. Mouth corner on vertical just in front of posterior nostril; tip of upper jaw reaching vertical just behind anterior rim of eye; pad over tendon to mouth corner as long as pad over maxilla. Preorbital reaching 1/4 up upper lip and on line joining midpoints of posterior and anterior nostrils; anterior nostrils c. 50% below vertical span of posterior nostrils; nostrils nearer each other than lip or eye; slight cutaneous rim around anterior nostril, Gill rakers short, type 4.

Pectoral fin reaching posterior rim of eye when laid forward in small fishes, not so far in large; reaching c. 1/2 along pelvic fin (not reaching tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from origin of pectoral fin than to that from first dorsal fin origin, its tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale reaching c. 1/2 along pelvic spine. First dorsal fin origin distinctly nearer snout tip than caudal base; sp. 1 longer than sp. 2, sp. 4 slight, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c. 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical c. 1/2 along anal fin base; tips of anterior rays reaching as far back as tips of posterior rays; anal fin and dorsal fins about the same height anal and second dorsal fins lightly scaled anteriorly and along base. Pyloric caeca 6.

DISTRIBUTION. Coasts of NE Asia from Vladivostok to Macao.

REMARKS. Widely known as *Mugil* or *Liza haematocheila*. The types of *L. lauvergnii* and *L. haematocheila* are identical. The syntypes of *L. joyneri* are also specifically identical. The synonymy of the other species is inferred from their descriptions. Within this genus only *L. tade* and *L. lauvergnii* have the tip of the upper jaw reaching as far as 1/3 eye diameter below the level of the lower rim of the eye. The fewer scales and markedly depressed head serve to distinguish *L. tade*. *L. lauvergnii* has the tip of the jaw reaching behind the vertical from the anterior rim of the eye. The arrangement of nostrils is found otherwise in this genus only in *L. abu*. Bleeker (1860a) recorded this species from Sumatra; but there is no other record south of Macao; the brief description suggests his fish was *Crenimugil crenilabris*.

***Liza luciae* (Penrith & Penrith, 1947)**

*Ellochelon luciae* Penrith & Penrith, 1947: 69, fig. 1, St Lucia Estuary. Holotype. SAM: 24697, St Lucia estuary, Penrith & Penrith.

MATERIAL EXAMINED. Holotype and 3 paratypes, 131-153mm SL from the St Lucia R. estuary, South Africa. SAM: 24697, 138mm, holotype of *L. luciae*, St Lucia estuary, Penrith & Penrith, 24307, 3 spec, 131-153mm, paratypes of *L. luciae*, St Lucia estuary Penrith & Penrith.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 8, P. 14, L<sub>1</sub> 24-26, tr. 9, ped. 7, pect. sc. 7, D<sub>1</sub> sc. 9, D<sub>2</sub> sc. 18. Scales pavement ctenoid, mucus canals long and slender; occasional scales with double canals. Body robust; head pointed, scale-free halfway to anterior nostrils; interorbital less than twice eye diameter, almost flat; eye diameter considerably greater than snout length. Adipose tissue rim around eye. Upper lip height 1/5 eye diameter. Anterior mandibular pores at rear of symphyseal groove, c.breadth of symphyseal knob apart; second pair of pores obvious, remainder obscure. Scattered curving teeth in upper lip; scattered ciliiform teeth in lower lip, c.7 tooth-breadths apart; teeth on vomer, palatines, pterygoids and tongue. Tongue domed with high median ridge. No papillae on mouth membrane. Mouth corner at vertical between anterior and posterior nostrils; tip of upper jaw reaching vertical between posterior nostril and anterior rim of eye. Pad over maxilla more than twice as wide as pad over tendon to mouth corner. Preorbital reaching 1/2 up upper lip, slightly above line joining midpoints of posterior and anterior nostrils; anterior nostril partly below vertical span of posterior nostril. Gill rakers moderately long, type 3.

Pectoral fin reaching anterior 1/2 of eye when laid forward, <1/2 along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from origin of pectoral fin than that from first dorsal fin origin; its tip reaching vertical from base of sp. 4 of first dorsal fin; axillary scale reaching c. 1/2 along pelvic spine. First dorsal fin origin nearer caudal base than snout tip; sp. 1 longer than sp. 2; sp. 4 long, thin, reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching about 2/3 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/2 along anal fin base; anterior rays reaching behind tips of posterior rays; anal fin higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins densely scaled. Caudal fin only slightly forked. Pyloric caeca 6.

DISTRIBUTION. E coast of South Africa.

REMARKS. This species is very similar to *L. vaigiensis* with which it had been confused. Its tail is forked, albeit feebly, whereas the trailing edge is almost straight in *L. vaigiensis* and the anal fin is falcate (more so than is indicated by Penrith & Penrith's figure) whereas in *L. vaigiensis* it is almost straight edged. The only other species of the genus to have a longitudinal scale count as low as *L. luciae* and *L. vaigiensis* is *L. grandisquamis* which has 9 anal rays and 15-17 pectoral rays.

***Liza macrolepis* (Smith, 1849)**

*Mugil macrolepis* Smith, 1849: pl. 28, fig. 2, rivers and freshwater lakes of South Africa; Bleeker, 1952c: 422, Borneo; 1860f: 54, Cape of Good Hope; Castelnau, 1861: 47, South Africa; Jordan & Evermann, 1903: 332, Taiwan; Boulenger, 1916: 94, fig. 56, Cape of Good Hope, Durban, Kosi Bay, Zululand, Rovumma R., Socotra, Seychelles, Rodriguez; Barnard, 1925: 309, pl. 12, fig. 2, Algoa Bay, Natal, Zululand; Fowler, 1925a: 209, Delagoa Bay; 1928a: 124, Kusaie, Vavau, Tonga, Ewa, Ponape, Apia, Jaluit, Pago Pago, Suva, Guam, Makema, Aitutaki, Bora Bora; 1932a: 444, Hong Kong; Pellegrin, 1933: 178, fig. 97, Madagascar, freshwater; Roxas, 1934: 415, pl. 1, fig. 6 Mangarin, Mondoro; Smith, 1935: 628, fig. 14, pl. 20, Mazeppa Bay, Durban, Isipingo R., Sinkwazi Lagoon, Kosi Bay; 1949: 322, fig. 886, Port Alfred, East London, Durban, Portuguese East Africa; John, 1955: 228, Kyamkulam L.; Munro, 1955: 94, pl. 16, fig. 263, Sri Lanka; 1967: 167, pl. 18, fig. 278, New Guinea; Matsubara, 1955: 491, Japan; Pillay, 1962: 551, pl. 1, fig. 2, Calcutta, Madras, Bombay, Chilka L., South Andamans, Ennore, Cochin.

*Liza macrolepis* Smith, 1948: 840, fig. 11, E London to Beira; 1949: 322, fig. 886, E London, Durban, Port Alfred, Portuguese E Africa; 1956: 722, Aldabra; Munro, 1955: 94, pl. 16, fig. 26, Sri Lanka; Fourmanoir, 1957: 72, fig. 53, rivers of Madagascar, Mozambique; Masuda et al., 1984: 119, pl. 104, fig. J, Japan; Kurunuma & Abe 1986: 207, pl. 24, Kuwait market; Shen, 1994: 439, pl. 138, fig. 2, Taiwan.

*Mugil borneensis* Bleeker, 1851a: 201, Borneo; 1851c: 419, Borneo; 1851d: 472, Riouw; 1852c: 412, Borneo; 1859a: 278, Indonesia; Günther, 1861b: 448, East Indies; 1877: 218, Tahiti; Kner, 1865: 228, Tahiti; Day, 1876: 357, pl. 16, Calcutta, Malaya; 1888: 353, Seas of India; 1889: 353, Madras, Calcutta; Chaudhuri, 1917: 498, Chilka L.; Weber & De Beaufort, 1922: 249, Singapore, Sumatra, Nias, Riouw, Bintag, Borneo, Celebes, Timor, Ambon, Ceram, Buru, Saaneke; Devasundaram, 1951: 249, Chilka L.; John, 1955: 228, Kyamkulam L.; Pandey & Sandhu, 1992: 276, fig. 62, Calcutta, India to Malay Archipelago.

*Liza borneensis* Kendall & Goldsborough, 1911: 258, Kusai, Savau; Herre, 1936b: 97 Tuamotu, Makatea.

*Mugil adustus* Bleeker, 1853d: 503, Sumatra.

*Mugil troschelii* Bleeker, 1858b: 386, Java, nomen nudum; 1859a: 277 Java; 1860d: 15, Borneo; 1874: 104, Madagascar; Günther, 1861b: 448, Point de Galle, Java, Sumatra, Borneo; Day, 1889: 355, Seas of India; Macleay, 1882: 362, New Guinea; Jordan & Evermann, 1903: 332, Taiwan; Jordan & Seale, 1907: 11, Luzon; Jordan & Richardson, 1908: 242, Singapore, Philippines; Weber & De Beaufort, 1922: 248, Singapore, Puluweh, Sumatra, Aru, N New Guinea; Singalur, Celebes, Java, Flores, Borneo,

TABLE 15. Biometrics of *Liza* spp (4), \* two definite rows with scattered teeth between. # row on lip edge with scattered teeth behind. Abbreviations as in Tables 2-4.

Species	<i>L. banggai</i>	<i>L. malinche</i>	<i>L. nana</i> <i>pacifica</i>	<i>L. trosselii</i>
Scale radii	5-9	6-11	5-9	5
D (± SL)	60-82.6	27.0-28.5	23.6	27.4-30.3
HL (%SL)	26.5-27.0	26.5-28.0	25.1	26.0-28.8
HW (%HL)	61.5-70.0	60.5-70.0	65	60.5-64.6
IO (%HL)	48.2-46.8	44.6-46.8	46	42.4-53.3
ED (%HL)	26.5-27.5	23.0-26.6	25.5	24.0-27
SnL (%HL)	18.1-19.0	19.0-25.6	22.4	24.1-27.3
UHL (%HL)	5.4-5.6	6.1-6.8	4.0	6.0-7.6
MW/ML	1.8-1.9	1.1-1.3	2	2.4-2.8
PL (%HL)	78.0-78.8	81.5-84.0	63.3	73.5-76.3
PB (%PL)	27.2-27.7	31.0-32.5	33.3	27.4-29.3
VL (%PL)	96.4-96.8	81.0-82.6	33.5	83.7-88.8
VAs (%VL)	40.5-41.8	46.1-49.7	41.4	41.6-48.3
Ped (%D)	40	44.0-46.0	47.8	46.9-49.0
TR(UL)	scattered	2+	2	1+
TR(LL)	1	1	0	scattered
LES	11-17	10-20	8	10-26
FES	13-18	10-21	23	13-34
Sp.2/Sp.1	2-7	3-3	7	7-10-11
Sp.3/Sp.2	1	1-1	3	1-3-4
GK	22-31/ 52-56	26-42/ 35-78	30-57	40-45/ 52-75
Pi	6	6-6	4	6

- Kangarung Is.; Fowler & Bean: 1922: 17, Taiwan, Philippines.  
*Mugil trosselii* Bleeker, 1860c: 86, Sumatra; Day 1889: 358, Malabar; Schultz, 1943: 80, Samoa.  
*Mugil trosselii* Day 1876: 358, India to Malaya.  
*Liza trosselii* Jordan & Seale, 1906: 217, Apia, Pago Pago; 1907: 11, Luzon; Oshima, 1919: 270, Taiwan; 1921: 71, Taiwan; Whitehouse, 1927: 89, Tuticorn; Tanaka, 1927: 742, pl. 163, Japan; Seale, 1935: 355, fig. 1, Malekula, Bushman Bay, Waia; John, 1955: 228, Kyamkulam L.  
*Liza trosselii* Kendall & Goldsborough, 1911: 256, Marshall Is.  
*Liza trosselii* Whitehouse, 1927: 89, Tuticorn.  
*Mugil smithi* Günther, 1861b: 447, Cape of Good Hope, freshwater; Castelnau, 1861: 47, South Africa; Bleeker, 1874: 104, Madagascar.  
*Mugil crenolepis* Castelnau, 1861: 49, Cape of Good Hope.  
 (?) *Mugil cinnamomo* Day 1865a: 141, Malabar.  
*Mugil rodericensis* Günther, 1876: 397, Rodriguez; Sauvage, 1891: 399, pl. 42, fig. 4, Madagascar.  
*Mugil olivaceus* Day, 1878: 357, W India, ascending rivers; 1889: 354, Seas of India.  
*Agonostomus dorsalis* Streets, 1878: 107, Samoa.  
*Chelon dorsalis* Schultz, 1946: 102, Samoa.  
*Liza akame* Tanaka, 1916: 395, Japan; Jordan & Hubbs, 1925: 208, Japan; Matsubara, 1955: 491, Japan.

*Liza pescadorensis* Oshima, 1922: 254, pl. 12 fig. 1, Taiwan; Wu, 1929: 82, fig. 65, Amoy; Matsubara, 1955: 491, Japan.

TYPE. Holotype: South Africa A. Smith. BMNH 1859.5.7.56.

MATERIAL EXAMINED. Holotype and 112 specimens, including the types of *M. rodericensis*, *M. borneensis*, *M. trosselii* and *A. dorsalis*, 45-303mm SL, from Cape Province, Natal, Madagascar, Seychelles, Tanzania, Rodriguez, Socotra, Persian Gulf, India, Sri Lanka, Borneo, New Guinea, Taiwan, Samoa and Tonga. BMNH: 1846.2.5.6, 109mm, locality unknown; 1855.5.7.56, 121mm, holotype of *M. macrolepis* and *M. smithi*, Cape Province, Smith; 1859.5.7.38, 164mm, Ceylon; 1861.11.7.56, 173mm, Ceylon; 1862.11.9.2., 250mm, Port Natal; 1862.12.6.10-11, 154 & 166mm, Taiwan; 1867.8.16.50, 152mm, Seychelles; 1871.9.13.136, 110mm, Tonga; 1876.3.11.30, 196mm, holotype of *M. rodericensis*, Rodriguez, in fresh water, Gulliver; 1876.3.11.11-14, 4 spec. 60-95mm, paratypes of *M. rodericensis* (Rodriguez) Gulliver; 1880.2.21.164-5, 101 & 115mm, Borneo, labelled 'syntypes of *M. borneensis*'; 1881.3.30.12-15, 4 spec. 87-138mm, Socotra; 1889.2.1.3686, 269mm Bombay; 1889.2.1.3696-7, 140 & 145mm, Malabar; 1889.2.1.3744-9, 6 spec. 47-74mm, Calcutta; 1889.2.1.3751-2.57 & 62mm, Akyah, Burma; 1889.2.1.3753-56, 4 spec. 51-75mm, locality unknown; 1889.2.1.3757-62, 6 spec. 53-67mm, Calcutta; 1889.2.1.3774, 75mm, Orissa; 1889.2.2.9, 193mm, Hadibu, Socotra; 1890.11.17.3, 192mm, Tongatabu; 1905.6.8.27, 224mm, Durban Bay; 1906.10.24.13, 188mm, Travancore; 1906.11.10.46, 313mm, Kosi Bay; 1913.12.9.189, 105mm, Mimika R. New Guinea; 1930.9.30.19, 139mm, E London; 1932.2.18.27-8, 62 & 67mm, Hor Kaur, Persian Gulf; 1936.10.5.10-11.36 & 47mm, Seychelles; 1951.5.9.2-5, 4 spec. 76-178mm, Wadi Meifa, 250 miles from Aden; 1957.4.24.17-23, 30-60mm, Suk, Socotra; 1957.4.24.76-94, 18 spec. 50-77mm, Hadibu, Socotra; 1957.4.24.101, 56mm, Mameia R., Socotra; 1969.2.11.210-14, 5 spec. 29-45mm, Tuva R., Tanzania. MNHN: 91-674-677, 4 spec. 86-119mm, Madagascar; 5537, 29-0 & 303mm Madagascar; A.2821, 119mm, north Sumatra. RMNH: 6403, 14 spec. 45-218mm, lectotype and paralectotypes of *M. borneensis* Borneo, Bleeker; 6402, 98 & 103mm, syntypes of *M. trosselii*, Java, Bleeker. AM: B.8007, 128mm, Java, labelled 'co-type of *L. trosselii*'; B.8064, 160mm, Borneo labelled 'co-type of *M. borneensis*'; 1.94, 109mm, Hooghly R.; I.7287, 166 & 173mm, Samoa. IM: 9472, 146mm, Chilka L. USNM: 15111, 30mm, holotype of *Agonostomus dorsalis*, Samoa, Steinberger.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 16, LI 33-34, tr 13, ped. 7, pect. sc. 9-10, D<sub>1</sub> sc. 11-12, D<sub>2</sub> sc. 22-24. Scales pavement ctenoid, variable number of dorsal and flank scales with 2-3 mucus canals. Body moderately robust, head bluntly pointed, scale-free halfway to anterior nostril; interorbital less than twice eye diameter, very slightly convex; eye diameter slightly longer than snout length. Adipose tissue rim around eye. Upper lip height 1/4 eye diameter. Anterior pair of mandibular pits slightly before rear end of symphysial groove and c. twice breadth of symphysial knob apart; 2 obvious and several obscure pairs behind. Row of peg-like teeth at edge of upper lip and another at base with scattered teeth between; ciliiform teeth on edge of lower lip; teeth on vomer, palatine, pterygoids and high-keeled tongue; 1 or 2 rows of broad papillae with long

axes perpendicular to lip edge at inner base of lower lip. Mouth corner at vertical just in front of posterior nostril; tip of upper jaw reaching to vertical from anterior rim of eye. Pad over tendon to mouth corner  $3/4$  length of pad over maxilla. Pre-orbital reaching  $>1/2$  up upper lip and on line joining midpoints of posterior and anterior nostrils; anterior nostril reaching slightly below vertical span of posterior nostril; nostrils nearer each other than lip or eye; posterior closer to eye than anterior to lip; slight cutaneous rim around anterior nostrils. Gill rakers short, type 4.

Pectoral fin reaching posterior half of eye in small fish, to anterior half of eye in larger, when laid forward, c.  $1/3$  along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin origin equidistant from verticals from origins of first dorsal and pectoral fins, its tip reaching vertical just behind base of sp. 4 of first dorsal fin; axillary scale not reaching past tip of pelvic spine. First dorsal fin origin nearer caudal base than to snout tip in specimens  $<180$  mm SL, but equidistant in larger fishes; sp. 1 longer than sp. 2, sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c.  $1/2$  along membrane behind sp. 4. Second dorsal fin origin at vertical c.  $1/2$  along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin about equal in height to both dorsal fins; second dorsal and anal fins scaled anteriorly and along base. Caudal fin deeply forked. Pyloric caeca 4-6.

DISTRIBUTION. Indo-Pacific from South Africa to Tonga and Taiwan, not recorded from Australia.

REMARKS. Günther (1861b) based his *M. smithii* on Smith's types of *M. macrolepis*, indicating that the name had been pre-occupied by Rüppell (1828) who had described *Mugil macrolepidotus* (= *L. vaigiensis*). As the spelling was not identical, presumably it is not a homonym of *macrolepis*. The recognition of *Chelon dorsalis* by Schultz (1946) is surprising as he had previously (1943) placed *Argonostomus dorsalis* in the synonymy of *L. troschelli*. Fowler (1928a) had referred *A. dorsalis* to *Valamugil scheli*, but the scale count is far too low for this species. There is nothing in the descriptions of the other species listed in the synonymy to differentiate them from *L. macrolepis*. The specimens from the Australian Museum, labelled as Bleeker's types, were actually supplied by Day and like many of the specimens Day distributed to various institutions are probably 'typical' examples rather than the specimens on which the original description was based. In particular the specimen labelled 'type of

*Mugil buchananii*' which Day supplied does not resemble the type of *M. buchananii* in Leiden. The only other members of the genus in which the tip of the pelvic fin reaches behind the vertical from the base of sp. 4 of the first dorsal fin are *L. abu* in which the tip reaches right to the end of the dorsal fin membrane, as well as *L. melinoptera* and *L. vaigiensis* in which the tip reaches about as far as in *L. macrolepis*. These 2 species have a lower longitudinal scale count than *L. macrolepis*.

#### *Liza mandapamensis* sp. nov.

HOLOTYPE. BPBM 20618. Type locality: Kilakarei, S of Mandapam, S India. Randall

MATERIAL EXAMINED. The unique holotype, BPBM 20618, 196 mm SL, of *L.* from Kilakarei, Mandapam.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 7. A III 8. P16, L1 33, tr. 10, ped. 7, pect. sc. 7, D<sub>1</sub> sc. 11, D<sub>2</sub> sc. 23. Scales pavement ctenoid, mucus canals moderately long; some anterodorsal and ventral scales with double canals. Body robust; head pointed, scale-free to just in front of anterior nostrils; interorbital less than twice eye diameter, slightly convex; eye diameter greater than snout length. Adipose tissue rim around eye. Upper lip, height  $1/6$  eye diameter. Anterior mandibular pores at posterior end of symphyseal groove, slightly more than breadth of symphyseal knob apart, posterior pores obscure. 2 rows of teeth in upper lip, short and spatulate along lip edge, finer teeth scattered along inner base of lip; lower lip edentate; no teeth on vomer or palatine, but teeth on pterygoids and domed tongue. No papillae at inner base of lower lip. Mouth corner at vertical between anterior and posterior nostrils; tip of upper jaw reaching vertical from anterior rim of eye; pad over tendon to mouth corner only  $1/4$  as long and  $1/4$  as wide as pad over maxilla. Preorbital reaching level of mid-gape and on line between midpoints of posterior and anterior nostrils; anterior nostrils extending slightly below vertical span of posterior nostrils; anterior nostrils nearer lip than posterior to eye. Gill rakers moderately long, type 3.

Pectoral fin reaching hind half of eye when laid forward, only c.  $1/8$  along pelvic fin (not nearly to tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from first dorsal fin origin than to that from origin of pectoral fin, its tip reaching vertical from base of sp. 2 of first dorsal fin; axillary scale reaching c.  $3/4$  along pelvic spine. First dorsal fin origin nearer snout tip than caudal base; sp. 1 equal to sp. 2 in length; sp. 4 weak, not reaching past vertical from tip of sp. 3 when fin

raised; axillary scale reaching midlength of membrane behind sp. 4. Second dorsal fin origin at vertical c. 1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin slightly higher than second dorsal fin, but not as high as first dorsal fin; second dorsal and anal fins scaled anteriorly and along base. Caudal fin forked. Pyloric caeca 4.

**DISTRIBUTION.** One locality in S India.

**REMARKS.** This species is notable for having only 7 dorsal rays, which is a rare occurrence in other mugilids. *L. mandapamensis* differs from other species of *Liza* with only 8 anal rays (*L. luciae* and *L. vaigiensis*) in having a greater longitudinal scale count. Other species that normally exhibit 9 anal rays, but have had individuals recorded with only 8 anal rays are *L. aurata*, *L. dumerili* and *L. subviridis*. Only the last occurs in the area from which *L. mandapamensis* was taken. It differs from *L. subviridis* in an apparently greater number of pectoral rays, a lower transverse scale count, in not having the adipose tissue covering part of the iris, and in various proportional measurements. As well as geographic separation *L. mandapamensis* has a higher scale count than either *L. aurata* or *L. dumerili*.

There remains the possibility that this fish is a hybrid; but what combination of parental characteristics would produce its features I cannot imagine.

### *Liza melinoptera* (Valenciennes, 1836)

*Mugil melinopterus* Valenciennes, 1836: 146(108), pl. 313, Vanicoro; Günther, 1861b: 452, Tonga; 1877: 218, Vanicoro, Tonga; Weber & De Beaufort, 1922: 246, Sinabong Bay, Simalur, Vanicoro, Samoa, Fiji; Fowler, 1932a: 444, Singapore; Roxas, 1934: 413, pl. 1, fig. 7, Philippines.

*Liza melinoptera* Jordan & Seale, 1906: 217, Apra, Pago; Herre, 1936b: 96 Suva, Fiji, Papeete Haibou, Tahiti.

*Mugil haematocelus* Richardson, 1846: 249, China, non Schlegel.

*Mugil ceramensis* Bleeker, 1852e: 699, Waihai, Ceram; 1959a: 277, Indonesian archipelago; 1859d: 368, Banka; Jordan & Seale, 1907: 11, Luzon; Weber & De Beaufort, 1922: 247, Sumatra, Banka, Java, Borneo, Sandir, Celebes, Timor, Ambon, Buruan, Ceram, Jobi, Nusa Laut; Roxas, 1934: 411, pl. 2, fig. 3, Philippines; Fowler, 1935: 141, Hong Kong; 1936a: 17, Hong Kong; 1939b: 81, Sorong; Scott, 1959: 121 Malaya.

*Liza ceramensis* Reeves, 1927: 8, Korea; Seale, 1935: 355, Malana; Munro, 1955: 94, Sri Lanka; John, 1955: 227, Kyankulam I.

?*Mugil compressus* Günther 1861b: 451 ?New South Wales, 1881: 217, pl. 123, fig. A, ?New South Wales.

*Mugil oligolepis* Day, 1876: 358, pl. 76, fig. 2, Sundabunds near Calcutta, India to Malaya, non Bleeker.

*Mugil aynooensis* Oshima, 1922: 245, pl. 11, fig. 2, Taiwan.

(?) *Mugil parva* Wu, 1929: 81, fig. 65, Amoy.

**HOLOTYPE.** Vanicoro, Quoy & Gaimard, MNHN A 3669.

**MATERIAL EXAMINED.** Holotype and 9 specimens, including the type of *M. ceramensis*, 60-222mm SL, from Fiji, Ceram, New Hebrides, Philippines, Caroline Is, Santa Cruz Is and Seychelles. BMNH: 1877.4.18.2, 128mm, Kandavu, Fiji; 1879.5.22.65, 222mm, Ponapé; 1927.4.14.82, 203mm, Seychelles; 1928.1.17.26, 66mm, Jordan R., Santo; 1933.3.11.732, 124mm, Dumaguete, Philippines. MNHN: A.3669, 150mm, holotype of *M. melinopterus*, Vanicoro, Santa Cruz Is, Quoy & Gaimard. RMNH: 640, 4 spec. 6-200mm, syntypes of *M. ceramensis* Ceram, Bleeker.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> 8, A III 9, P (14) 15, L1 27-31, tr. 9-10, ped. 7, pect. sc. 7-8, D<sub>1</sub> sc. 10-11, D<sub>2</sub> sc. 18-19. Scales pavement ctenoid, mucus canals elongate; occasional scales with double or Y-shaped canals. Body robust, head pointed, less so in older fish; scale-free to anterior rim of eye; interorbital less than twice eye diameter, almost flat; eye diameter equal to snout in young fish, longer in older fish. Adipose tissue extending slightly over iris. Upper lip height < 1/4 eye diameter. Anterior mandibular pores at rear of symphyseal groove, about twice breadth of symphyseal knob apart; 3 obscure pairs of pores behind. Short slightly curving teeth along edge of upper lip with scattered fine teeth behind; scattered ciliiform teeth in lower lip; small patch of teeth on vomer of largest specimen examined, none apparent in others; lacking on palatines, but present on pterygoids and high-keeled tongue. Broad papillae with long axes perpendicular to lip edge at inner base of lip. Mouth corner at vertical slightly in front of posterior nostril; tip of upper jaw reaching vertical from anterior rim of eye; pad over tendon to mouth corner c. 2/3 length of pad over maxilla. Preorbital reaching 3/4 up upper lip, above line joining midpoints of posterior and anterior nostrils. Anterior nostril 50% below vertical span of posterior nostril; posterior nostril nearer eye than anterior to lip. Gill rakers short, type 4.

Pectoral fin reaching posterior half of eye when laid forward, c. 1/3 along pelvic fin (not to tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral fin origin than to that from first dorsal fin origin; axillary scale reaching c. 1/2 along pelvic spine. First dorsal fin origin distinctly nearer caudal base than to snout tip in small fish, but equidistant in large; sp. 1 variously shorter or longer than sp. 2; sp. 4 weak, not reaching behind vertical from sp. 3 when fin raised; axillary scale reaching c. 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; relative height of median fins variable; second dorsal



and anal fins densely scaled; caudal fin deeply forked. Pyloric caeca 6.

DISTRIBUTION. Indo-Pacific from Natal to Samoa and S China.

REMARKS. 4 of the 6 syntypes of *Mugil cera-mensis* conform to the description of *L. melinoptera*, but 2 specimens of 59 and 65mm SL have well-developed adipose eyelids and are specimens of *L. subviridis*. *Mugil oligolepis* of Day (1876) appears to have been *L. melinoptera* on the evidence of scale count, the length of the pectoral fin, the equality of eye diameter and snout length and the ratio of mouth width to mouth length. Wu (1929) referred to *M. parva* Oshima, a fish which from his description is *L. macrolepis*. *Mugil compressus* Günther 1861b: 451 and 1876: 217 was inadequately described. Gunther's description could apply to *Liza melinoptera* in the Pacific and to *L. grandisquamis* in the Atlantic. Indeed the holotype of *M. compressus* is a specimen of *L. grandisquamis* but is labelled as from New South Wales which must be an error or a case of switched labels. Some authorities have referred the species to *L. subviridis* but the adipose eyelid is well-developed in that species whereas Günther described *M. compressus* as being without one. Likewise the adipose eyelid is well developed in *L. parmata* which otherwise would fit Günther's description. The similarity between *L. melinoptera* and *L. grandisquamis* has already been commented upon under the latter species. *L. melinoptera* is very like *L. subviridis* but lacks the latter's extensive adipose eyelid, has fewer transverse rows of scales and has 6 pyloric caeca.

### *Liza parmata* (Cantor, 1850)

*Mugil parmatus* Cantor, 1850: 1076, Penang; Bleeker, 1855c: 400, Java; 1859a: 276, Indonesian archipelago; 1860d: 42, Borneo; 1861d: 76, Penang.

*Mugil dussumieri* Bleeker, 1848: 637, Sumbawa, non Valenciennes.

*Mugil macrolepis* Bleeker, 1852c: 422, Borneo; 1852e: 701, Ceram, non Smith.

*Mugil oligolepis* Bleeker, 1859a: 275, Indonesian archipelago; 1859e: 437, Sumbawa; 1860d: 40, Borneo; Günther, 1861b: 449, Borneo, Sumbawa; Fowler, 1905: 496, fig. 10, Borneo; 1925b: 209, Delagoa Bay; 1939a: 46, Gulf of Thailand; Weber & De Beaufort, 1922: 245, Borneo, Sumbawa, North Celebes, Malacca; Pellegrin, 1933: 181, Madagascar; Roxas, 1934: 413, Philippines; Smith, 1935: 635, fig. 17, pl. 21, fig. B, Isipingo Lagoon; Herre, 1936b: 95, Suva; Pandey & Sandhu, 1992: 277, Sanderbunds near Calcutta, India to Malay Archipelago.

*Liza oligolepis* Jordan & Richardson, 1908: 244, Philippines; Smith, 1948: 840, fig. 10, Isipingo to Delagoa Bay; 1949: 321, fig. 885, Isipingo to Delagoa Bay; Matsubara, 1955: 491, Japan; Munro, 1955: 94, pl. 16, fig. 26, Sri Lanka.

TYPE. None. Type locality, Oenang.

MATERIAL EXAMINED. 11 specimens, including the types of *M. oligolepis*, 28-88mm SL from Borneo and the Northern Territory of Australia. BMNH: 1844.1.1.18, 88mm 'South Australia' (= Northern Territory); 1894.1.19.41-2, 65 & 70mm, Sarawak. RMNH: 6405, 7 spec. 28-77mm, holotype and paratypes of *M. oligolepis*, Borneo, Bleeker. AM: B.8022, 73mm, Borneo labelled: '*M. oligolepis* syntype coll. Bleeker.'

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P (14) 15, L1 26-28, tr. 9-10, ped. 7, pect. sc. 9-10, D<sub>1</sub> sc. 9-10, D<sub>2</sub> sc. 18-19. Scales pavement ctenoid; head bluntly pointed, scale-free to posterior nostril; interorbital less than twice eye diameter, slightly convex; eye diameter longer than snout. Adipose tissue intruding over iris. Upper lip median height c.1/4 eye diameter. Anterior mandibular pores 1/2 hidden in lateral walls of symphyseal groove; a more prominent pair of pores behind symphyseal groove, others obscure. Lips edentate; no teeth on vomer or palatines, but on pterygoids and high-keeled tongue. Row of low papillae with long axes perpendicular to lip edge at inner base of lip. Mouth corner at vertical between anterior and posterior nostrils; tip of upper jaw reaching vertical between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner more prominent than pad over maxilla. Preorbital reaching 3/4 up upper lip, slightly above line joining midpoints of posterior and anterior nostrils; anterior nostril wholly below vertical span of posterior nostril; anterior nostril nearer lip than posterior to eye; slight cutaneous rim around anterior nostrils. Gill rakers short, type 4.

Pectoral fin reaching anterior half of eye when laid forward, just reaching vertical from origin of first dorsal fin and c.2/3 along pelvic fin (not quite to tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral fin origin than to that from origin of first dorsal fin, its tip reaching vertical almost at end of fin membrane behind sp. 4 of first dorsal fin; axillary scale reaching c.1/2 along pelvic spine. First dorsal fin origin nearer caudal base than to snout tip; sp. 1 markedly longer than sp. 2; sp. 4 slender, but relatively long, reaching just behind vertical from tip of sp. 3 when fin raised.; axillary scale reaching behind end of fin membrane behind sp. 4. Second dorsal fin origin on vertical almost 1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fins slightly higher than subequal dorsal fins; second dorsal and anal fins lightly scaled anteriorly and along base. Pyloric caeca 7.

DISTRIBUTION. W Pacific.

**REMARKS.** The relatively long pectoral fin and long pelvic fins together with the long dorsal axillary scales give this species a superficial resemblance to *Valamugil*, an appearance heightened by the slight visibility of the pad over the maxilla below the mouth corner when the mouth is closed. But *L. parvata* lacks the long pectoral axillary scale and the fimbriate membranous-edged scales typical of *Valamugil*. The small number of scales in the longitudinal series differentiate *L. parvata* from the other members of the genus with 9 anal rays. The reference of 1 BMNH specimen to 'South Australia' dates from a time when the Northern Territory was part of the colony of South Australia.

### *Liza parvia* (Hamilton Buchanan, 1822)

*Mugil parvia* Hamilton Buchanan, 1822: 215, 380, pl. 17, fig. 71, Hooghly R., Valenciennes, 1836: 144(107), Bengal, Malabar; Günther, 1861b: 426, fig., Calcutta, Karachi, rivers of Bengal; Day, 1865: 14, Malabar; 1876: 350, pl. 75, fig. 2, Hooghly R. at Calcutta; 1889: 344, seas and estuaries of India; Pillay, 1962: 553, pl. 1, fig. 3 (part), Calcutta, Akyab; Pandey & Sindhia, 1992: 265, Hooghly R. at Calcutta, seas and estuaries of India.

*Liza parvia* Munro, 1955: 93, pl. 16, fig. 258, Sri Lanka.

**TYPE.** Syntypes: Ganges R., Hamilton Buchanan, BMNH 1858.8.15.91.

**MATERIAL EXAMINED.** Syntypes and 6 specimens, 92–159mm SL from the Ganges River, Calcutta, Madras and Karachi. BMNH: 1858.8.15.91, 88 & 95mm, syntypes of *M. parvia*, Ganges R., Waterhouse; 1860.3.19.726, 112mm, Calcutta; 1889.2.1.3689-90, 167 & 172mm, Calcutta; 1889.2.1.3691, 96mm, Madras; 1889.2.1.3700, 109mm, Madras; 1898.6.29.166, 141mm, Karachi.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> 8, A III 9, P 15, L<sub>1</sub> 31–35, tr. 11, ped. 7, pect. sc. 8–9, D<sub>1</sub> sc. 11, D<sub>2</sub> sc. 21. Scales pavement ctenoid, mucus canals short to moderately long; no multicanaliculate scales. Body moderately robust; head bluntly pointed, scale-free halfway to anterior nostrils; interorbital slightly less than twice eye diameter, slightly convex; eye diameter slightly greater than or equal to snout length. Adipose tissue covering 2/3 of posterior iris, rather less anteriorly. Upper lip median height 1/4–1/3 eye diameter. Anterior mandibular pores at rear of symphyseal groove, c. breadth of symphyseal knob apart; 5 other pairs behind; short slender teeth on edge of upper lip, indefinite row of smaller teeth at inner base of upper lip; lower lip edentate, no teeth on vomer or palatines, but present on pterygoids and high-keeled tongue; row of broad papillae at inner base of lower lip; mouth membrane with small fine papillae. Mouth corner on vertical from posterior nostril; tip of upper jaw reaching vertical between

posterior nostril and anterior rim of eye. Pad over tendon to mouth corner c. 1/2 as wide and 3/4 length of pad over maxilla. Preorbital reaching 1/2 up upper lip, slightly above line joining mid-points of posterior and anterior nostrils; anterior nostril almost wholly below vertical span of posterior nostril in young fish, overlapping c. 50% in largest. Gill rakers moderately long, type 4.

Pectoral fin reaching hinder edge of pupil in small fish, not quite to hinder rim of eye in larger when laid forward, only c. 1/2 along pelvic fin (not reaching tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral fin origin than that from origin of first dorsal fin, its tip reaching vertical from base of sp. 3 of first dorsal fin or slightly behind; axillary scale not reaching past tip of pelvic spine. First dorsal fin origin slightly nearer snout tip than caudal base; sp. 1 shorter than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c. 1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/3–1/2 along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal and dorsal fins approximately equal in height; second dorsal and anal fins densely scaled; caudal fin deeply forked. Pyloric caeca 5.

**DISTRIBUTION.** Coasts of Pakistan and India.

**REMARKS.** *L. parvia* is the only member of the genus whose mid-gape is at a level above mid-pupil. Otherwise it is very similar to *L. tade* and *L. subviridis* but lacks the depressed pointed head of the former which also has teeth on its vomer and palatines. *L. subviridis* has a relatively short snout and its mouth corner does not reach as far back as in *L. parvia*. On the basis of a biometrical study of specimens from the type localities of *L. dussumieri* (= *L. subviridis*) and *L. parvia* Sarojini (1953) concluded that these 2 species were identical. The fishes she studied probably were, but her description does not accord with the characters of *L. parvia* which are quite distinct from those of the type specimens of *L. dussumieri* and *L. subviridis*.

### *Liza ramada* (Risso, 1826)

*Mugil cephalus* Grunov, 1763: 162, European seas; Donovan, 1802: 1, pl. 15, England; Turton, 1807: 106, Britain; Neill, 1808: 544, Britain; Fleming, 1828: 217, Britain, non Linnaeus.

*Mugil cephalus* var. A Risso, 1810: 344, Nice.

*Mugil ramada* Risso, 1826: 390, Nice; Roule, 1925: 50, fig. 21, France; Chevey, 1929: 338, fig., Northern Atlantic; Lozano Rey, 1935: 245, pl. 13, fig. 2, Spain; 1947: 724, pl. 19, fig. 2, Spain; Fowler, 1936: 587, Asinara, Italy; Arce, 1938: 98, figs 16–18, Gulf of Genoa; Joulin,

TABLE 16. Biometrics of *Liza* spp (5). \* secondary radii. # row of teeth on lip edge with scattered teeth behind. ^ 2 rows of teeth with scattered teeth between. Abbreviations as in Tables 2-4.

Species	<i>L. parvata</i>	<i>L. parvia</i>	<i>L. ramada</i>	<i>L. richardsoni</i>	<i>L. saliens</i>	<i>L. subviridis</i>	<i>L. tade</i>	<i>L. tricuspidens</i>	<i>L. vaigiensis</i>
Scale radii	6	6-8	10-12 + 2-4*	5-10	7-10 (+3-4)*	8-10	6-7	6 (+4-5)*	6-8
D (%SL)	30.0-35.0	23.5-26.0	23.0-24.0	22.2-22.6	18.5-21.0	23.3-27.0	18.5-22.5	23.6-26.4	25.5-29.5
HL (%SL)	25.0-27.2	23.5-26.0	24.0-25.0	24.7-28.0	18.0-21.0	23.0-23.5	19.0-25.5	23.1-25.0	24.4-34.6
HW (%HL)	70.3-76.9	65.4-70.8	63.4-65.0	58.5-65.5	60.2-64.8	76.3-77.5	69.0-71.0	55.3-61.2	83.9-84.3
IO (%HL)	42.1-50.8	40.5-47.1	42.4-43.3	37.5-40.0	38.0-39.5	42.5-44.0	43.5-47.5	41.7-42.2	53.3-58.7
ED (%HL)	27.2-31.0	21.0-27.2	20.7-21.0	25.0-25.4	20.7-26.0	22.8-24.2	14.2-22.8	21.0-25.0	21.9-32.1
SnL (%HL)	20.8-23.6	21.6-27.1	20.5-21.0	25.0-25.4	22.1-25.2	17.5-18.2	14.0-23.2	21.7-26.0	19.5-20.0
ULH (%HL)	6.2-7.0	6.6-6.8	5.3-7.5	5.6-6.6	4.0-6.7	7	3.3-4.2	7.9-9.2	5.8-6.3
MW/ML	3.2-4.6	3.0-3.6	2.0-2.6	1.7-2.1	2.0-2.7	3.0-3.3	2.1-2.6	2.2-2.7	2.25-2.8
PL (%HL)	83.5-100	76.5-78.5	71.5-72.5	57.0-68.0	87.4-94.8	74.1-75.8	75.5-78.8	80.2-84.8	94.4-95.4
PB (%PL)	22.8-28.3	25.0-25.5	33.3-34.5	31.2-36.0	23.7-28.0	32.0-36.5	30.0-35.0	26.9-30.0	30.6-31.4
VL (%PL)	95.0-100	85.0-90.0	85.3-99.7	83.3-92.8	64.5-66.0	83.2-90.0	82.3-89.7	70.2-76.0	80.0-89.5
VAX (%VL)	40.6-42.0	38.2-44.8	41.4-42.5	52.5-59.0	55.3-57.7	39.0-41.0	47.2-53.6	41.3-44.5	35.2-35.8
Ped (%D)	46.8-49.8	50.4-55.6	45.3-48.7	50	47.5-50.0	52.4-53.5	58.5-65.0	48.5-58.8	50.4-54.3
TR(UL)	0	2	1+s*	1+s*	1+sc#	1+sc#	5-9	2+sc^	1-2,
TR(LL)	0	0	1	0	0	1	1	0	1
LES	8-16	10-15	12-15	16-19	19-21	6-9	13-17	20-23 12-13	
FES	5-12	16-24	12-16	10-13	16-21	11-14	14-24	7-12	16-24
Sp.2/Sp.1	3.2-4.5	3.2	2.4	2.8	3.4	3.7	3.5	2.8	2.7
Sp.3/Sp.2	1.3-1.4	1.5	1.5	1.8	1.5	1.5	1.3	1.5-1.7	1.2-1.4
GR	20-28/ 30-45	26-38/ 50-76	58-92/ 100-115	30-35/ 50-57	25-30/ 40-47	30-36/ 40-65	36-45/ 48-70	32-34/ 55-62	28-32/ 40-61
PC	7	5	6-8	4	8	4-5	5	6	14-16

1938: 338, fig., Mediterranean to Egypt, Atlantic, North Sea to Cape of Good Hope; Heldt 1948: 5, figs 4-5, Tunisia; Nikolskii, 1954: 402, Black Sea, Mediterranean; Dantec, 1955: 97, pls 4-8, Arcachon; Dollfus, 1955: 138, Atlantic coast of Morocco; Albuquerque, 1956: 607, Coast of Portugal; Bograd, 1961: 179, Israel; Bănărescu, 1964: 622, Black Sea; Svetovidov, 1964: 214, fig. 61, Black Sea; Blanc & Hureau, 1968: 26, European seas.

*Liza ramada* Fowler, 1919: 251, West Africa; Buen, 1935: 95, coast of Spain; Dieuzeide et al, 1935: 238, fig., Algerian lakes, Tunis; Wheeler, 1969: 464, fig. 316, British isles, Norway, Mediterranean; Hickling, 1970: 609, Britain; Trewavas & Ingham, 1972: 17, fig. 1c, European seas; Tortonesi, 1972: 29, Genoa, Magra, Venetian Lagoon, Cattalia, L. Trasimene, Naples, L. Patria, Patraso, Nile R. at Cairo; Bauchot & Pras, 1980: 301, fig. 27c-d, Morocco to Norway, Mediterranean.

*Mugil (Liza) ramada* Borcea, 1934: 260, figs 5-8, Roumanian coast, Black Sea; Soljan, 1948: 205, fig., Adriatic Sea; Cabo, 1979: 184, fig. 54, Mar Menor.

*Mugil capito* Cuvier, 1829: 232, Nice, Mediterranean, La Rochelle, Atlantic shores of France; 1830: 62, Mediterranean; Bonaparte, 1834: 31, pl. 92, fig. 1, Italy; Jenyns, 1835: 374, Great Britain; Valenciennes, 1836: 36(26), Norway, seas of Europe; Bancroft, 1836: 232, seas of Europe; Yarrell, 1836: 200, fig., Britain; 1841: 234, Britain; 1859: 175, Britain; Guichenot, 1850: 67, Algeria; Nilsson, 1855: 176, Scandinavia; Günther, 1861b: 439, fig., Firth of Forth, Devonshire, Lisbon, Dalmatia, Tunis, Nile R., Nice; Lloyd, 1867: 145, Cairo, Tunis in

fresh water; Steindachner, 1868: 680, Spain & Portugal; Capello, 1868: 53, Madeira; Day, 1881: 230, p. 6, Britain & Ireland; Moreau, 1881: 188, France; Rochebrune, 1882: 95, Senegambia; Lortet, 1883: 134, pl. 11, fig. 2, Syria; Smitt, 1893: 339, fig. 90, Scandinavia; Carus, 1893: 706, Mediterranean; Tillier, 1902: 292, Suez Canal; Boulenger, 1907: 432, pl. 80, fig. 2, R.Nile; 1916: 83, fig. 49, Gemil, L. Menzaleh, R. Nile, Sammud, Cairo, Ghet-el-Nassara, Bahr-el-Tamila, L. Temeseh, Maz Agan (Morocco); Antipa, 1909: 82, fig. 27a-f, Black Sea; Ninni, 1909: 315, Adriatic; Athanassopoulos, 1919: 266, Mediterranean; Pellegrin, 1914: 31, Morocco; 1921: 190, fig. 90, Morocco, Tunisia; 1923: 325, fig. 70, Senegal; Mohr, 1921: 38, North Sea; Joubin & Le Danois, 1924: 59, fig., France; Nobre, 1935: 325, pl. 44, fig. 143, Portugal; Gruvel & Chabanaud, 1937: 13, fig. 17, Suez Canal; Morovic, 1957: 2, fig., Adriatic; Ladiges & Vogt, 1965: 15, pl. 35, fig. 145, fresh water, rivers of Europe; Bini, 1968: 33, fig. Italy.

*Mugil (Liza) capito* Jordan & Swain, 1885: 261, European seas.

*Liza capito* Popov, 1929: 246 Black Sea; 1930: 77, fig. 44, pl. 3, fig. 3, 4, Egypt, Naples, Palermo; Cadenat, 1954: 26, Atlantic coast of Morocco.

(?) *Mugil britannicus* Hancock, 1830: 60, Britain.

*Mugil dubahra* Valenciennes, 1836: 60(43), Nile R.

*Mugil octoradiatus* Günther, 1861b: 437, fig., England, non Günther 1861a; Lortet, 1883: 132, pl. 11, fig. 13 (part), Syria.

*Mugil petherici* Cuvier, 1861b: 441, Nile R. at Cairo and Khartoum.

*Mugil aurata* Latte, 1883: 133, (part), mouth of Nile R., Beirut, Antioch, non Risso.

*Myxus maroccanus* Mohr, 1927: 191, fig. 13, Morocco.

TYPE. None. Type locality, Nice.

MATERIAL EXAMINED. 192 specimens, including the types of *M. capito*, *M. dubahra* and *M. maroccanus*, 75-545mm SL, from the Mediterranean, British Channel Is., France and NW Africa. BMNH: 1837.3.29.24, 165mm, locality unknown; 1839.2.4.143, 160mm, English coast; 1866.12.10.23, 290mm, London market; 1860.4.22.36, 223mm, Lisbon; 1860.4.22.42, 280mm, Lisbon; 1860.4.22.53, 167mm, Lisbon; 1860.11.9.53, 111mm, Mediterranean; 1861.3.9.2-3, 272 & 280mm, London market; 1861.5.27.15-16, 76 & 98mm, Mogadore; 1861.9.9.1-4, 4 spec. 178-200mm, R. Nile; 1861.9.9.5, holotype of *M. petherici*, R. Nile at Cairo; 1861.9.9.51-6, 184 & 192mm, R. Nile; 1861.11.20.1-3, 3 spec. 213-237mm, Seville; 1865.11.9.3, 24 & 35mm, locality unknown; 1871.9.2.3, 16 spec. 48-78mm, L. Timsch; 1871.9.9.4, 52mm, L. Timsch; 1885.1.29.19, 290mm, Gahcia; 1885.12.30.79, 226mm, Oporto; 1887.3.29.28, 164mm, Minha; 1892.1.15.4, 455mm, Penzance; 1896.5.20.31-2, 43 & 44mm, Seville; 1903.7.1.1-2, 102 & 220mm, Mazagan, Morocco; 1906.11.20.4, 204mm Madeira; 1907.3.1.1, 222mm, Newhaven; 1907.2.12.11, 368mm, London market; 1907.12.2.2807, 39mm, L. Menzaleh; 1907.12.2.2821-30, 10 spec. 78-248mm, L. Menzaleh; 1907.12.2.2831-2, 3 spec. 86-115mm, L. Menzaleh; 1907.12.2.2835-43, 9 spec. 34-65mm, L. Menzaleh; 1907.12.2.2844-5, 158 & 166mm, L. Menzaleh; 1907.12.2.2847, 67mm, L. Menzaleh; 1907.12.2.2848-51, 4 spec. 115-126mm, L. Menzaleh; 1920.12.23.20, 169mm, Askalon; 1925.9.19.85, 90, Port Said; 1925.9.19.86-7, 5 spec. 38-54mm, L. Timsch; 1925.9.19.88, 172mm, Salt Lake, Suez Canal; 1925.9.19.90, 119mm, Ismailia Lagoon; 1928.1.21.69, 198mm, Thraee; 1928.12.1.71-80, 22 spec. 10-16mm, Kargia, Gulf of Saloonia; 1934.1.26.1-3, 3 spec. 120-124mm, Yarmouth; 1935.3.5.53, 166mm, Haifa; 1949.9.16.475-86, 12 spec. 78-124mm, R. Naamen, Israel; 1962.6.29.1666-77, 21 spec. 13-35mm, Isle of Man; 1962.7.30.759, 165mm, Port Erin; 1963.5.14.489-514, 25 spec. 18-32mm, Banyuls; 1964.8.6.28-31, 4 spec. 288-330mm, Barrow-in-Furness; 1967.8.11.3-4, 282 & 330mm, R. Yealm; 1968.12.13.452-461, 10 spec. 75-120mm, Khebir R., near Larakia; 1970.4.9.22-6, 5 spec. 174-199mm, Lymington; 1970.6.19.319-26, 8 spec. 188-243mm, Guernsey; 1970.12.1.6-7, 286 & 292, E Thraee. MNHN. A.3587, 220mm, lectotype of *M. capito*, La Rochelle, d'Origny; A.3581-3, 5 spec. 67-127mm, paralectotypes of *M. capito*, Abbeville, Baillon; A.3586, 243mm, paralectotype of *M. capito*, Sicily, Eibron; A.3585, 175mm, paralectotypes of *M. capito*, R. Nile, Ehrenberg; A.3593, 180 & 227mm, paralectotypes of *M. capito*, Bordeaux, Magin; A.3748, 365mm, paralectotype of *M. capito*, L. Bizerta, Mareschaux; A.3750, 425mm, paralectotype of *M. capito*, Martingues, Della-lande; A.4699, 153mm, paralectotype of *M. capito*, Abbeville, Baillon; A.4701, 265mm, paralectotype of *M. capito*, Abbeville, Baillon; A.3730-2, 5 spec. 131-245mm, syntypes of *M. dubahra*, R. Nile, coll. Ehrenberg. ZIZM: H.75, 52mm, holotype of *M. maroccanus*, Morocco, Mohr.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> I 8, A III 9, P 18, L I 41-46, tr. 14-15, ped. 11, pect. sc. 11, D<sub>1</sub> sc. 15, D<sub>2</sub> sc. 27-28. Scales pavement ctenoid; mucus canals moderately long, extending only slightly posterior to focus; no multicanalliculate scales. Body slender, elongate; head pointed, scale-free halfway to anterior nostrils; interorbital rather more than twice eye diameter, slightly convex;

eye diameter equal to or very slightly shorter than snout. Adipose tissue rim around eye. Upper lip median height 1/3-1/4 eye diameter; upward fold at end of lower lip covering tip of upper lip. Anterior mandibular pores at posterior end of symphyseal groove, about breadth of symphyseal knob apart; second pair, further apart, behind, others obscure. Fine curving teeth on edge of upper lip, scattered teeth behind; row of ciliiform teeth on lower lip; teeth on vomer, palatines, pterygoids and low-domed tongue; teeth on tongue curve sharply backwards; tongue and mouth membrane finely papillate. Mouth corner at vertical from anterior nostril; tip of upper jaw reaching vertical midway between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner as long as pad over maxilla, but narrower. Preorbital reaching 1/2 up upper lip, on line joining midpoints of posterior and anterior nostrils; anterior nostril extending slightly below vertical span of posterior nostril; nostrils closer to each other than to lip or eye; anterior nostril nearer lip than posterior to eye. Gill rakers moderately long, type 4.

Pectoral fin not reaching to posterior rim of eye when laid forward; only 1/2 along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral fin origin than to that from origin of first dorsal fin. Second dorsal fin origin at vertical 1/4 along anal fin base; tips of anterior rays reaching behind tips of posterior rays in fish >200mm SL; anal fin slightly higher than second dorsal fin and both higher than first dorsal fin; second dorsal and anal fins lightly scaled anteriorly and along base; caudal fin moderately forked. Pyloric caeca 6-8.

DISTRIBUTION. Black Sea, Mediterranean, E Atlantic N of Cape Verde to North Sea and Baltic.

REMARKS. The identity of *M. capito* with *M. ramada* Risso was established by Trewavas & Ingham (1972). These authors also suggested that *Myxus maroccanus* of Mohr (1921) might be this species. Examination of the type confirms this view. The specimen, though shrivelled, has the typical lips of *L. ramada*, i.e., thickish upper lips whose extremities are hidden by an upfold of the lower lips. The types of *M. petherici* and *M. dubahra* are *L. ramada*. The description of *M. britannicus* is not inconsistent with *L. ramada*, but is insufficiently detailed for certain identification. The nature of the lips of *L. ramada* distinguishes the species from all members of the genus except *L. richardsoni* which, with *L. aurata*, are the most like *L. ramada* in general features. *L. richardsoni* differs in having the origin of the pelvic fin nearer

the vertical from the first dorsal fin origin rather than to the vertical from origin of the pectoral fin, the pectoral fin is relatively short, the interorbital is narrower, its gill rakers are of type 3 and it has fewer pyloric caeca. *L. aurata* differs from *L. ramada* in the shape of the preorbital and the fewer scale rows down the caudal peduncle, the longer pectoral fin and the lower gill raker count. Boulenger (1916) suggested that *M. auratus* of Lortet was *M. capito* (= *L. ramada*) and Trewavas who has examined Lortet's specimens reports (pers. comm.) that the preorbital of 5 specimens (Lyon 2923 & 2915) has not the shape typical of *L. aurata* and considers them to be young *L. ramada*. 2 other specimens (Lyon 2920 & 2925) are *Mugil cephalus*.

#### *Liza richardsoni* (Smith, 1849)

*Mugil richardsoni* Smith 1849: pl. 29, fig. 1, Cape of Good Hope; Günther 1861b: 443, Cape seas; Kner, 1865: 227, pl. 29, fig. 1, Cape of Good Hope.

*Liza richardsoni* Poll, 1959: 269, fig. 95, SW Africa.

*Mugil (Liza) richardsoni* Smith, 1965: 22, pl. 2, fig. C, South Africa.

*Mugil multilineatus* Smith, 1849: pl. 30, fig. 2, 2a; Günther, 1861b: 443, coasts and rivers of the Cape; Bleeker, 1860f: 54, Cape of Good Hope.

*Mugil capito* Gilchrist & Thompson, 1911: 44, Natal; Boulenger, 1916: 83, fig. 49 (part), Angola, Cape of Good Hope, Table Bay, Berg R.; Lampe, 1914: 228, Simonstown; Barnard, 1925: 304, Table Bay to Natal; Pellegrin, 1933: 169, fig. 90, Table Bay, Natal; Smith, 1935: 613, figs 8-9, pl. 17, fig. C, pl. 19, fig. A-F, Walfisch Bay, Lamberts Bay, Table Bay, False Bay, C. Agulhas, Port Beaufort, Knysna, Plettenberg Bay, Port Elizabeth, Port Alfred, Great Fish Point, East London, Mazeppa Bay, Durban, Sinkwazi, non Cuvier.

*Mugil saliens* Boulenger, 1916: 85 (part), Cape of Good Hope, Table Bay, James R., R. Chalumna.

*Liza ramada* Smith, 1948: 840, fig. 12, Cape Town to St Lucia; 1949: 322, fig. 887, Natal, Cape Agulhas, non Risso.

TYPE. Syntypes: Cape of Good Hope, A. Smith, BMNH 1844.2.15.53-4.

MATERIAL EXAMINED. Syntypes and 14 specimens, 39-294mm SL, from Walvis Bay, Damaraland, Table Bay and Berg River. BMNH: 1844.2.15.53-4, 148 & 153mm, syntypes of *M. richardsoni*, Cape of Good Hope, A. Smith; 1855.9.19.170, 131mm, Cape of Good Hope; 1865.8.28.32-3, 128 & 137mm, Damaraland; 1898.12.11.2, 282mm, Table Bay; 1914.5.15.1-2, 245 & 255mm, Table Bay; 1914.5.15.5, 130mm, St. James, Cape Town; 1935.3.20.191-6, 6 spec. 39-54mm, Walvis Bay; 1935.5.2.199-200, 118 & 140mm, Cape Town.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A ii 9, P 18, L 143-45, tr. 15, ped. 11, pect. sc. 10-11, D<sub>1</sub> sc. 14-15, D<sub>2</sub> sc. 28. Scales pavement ctenoid, mucus canals moderately long, not reaching far behind focus; occasional dorsal scale with double canals. Body slender; head pointed, scale-free to anterior nostril; interorbital less than twice eye diameter, almost flat; eye diameter not quite as long as snout.

Adipose tissue rim around eye. Upper lip median height <1/3 eye diameter; upward fold at ends of lower lip covering ends of upper lip. Anterior mandibular pores at rear of symphyseal groove c. breadth of symphyseal knob apart; 2 other pairs, twice as far apart, obvious, others obscure. Mandibular angle acute to barely obtuse. Fine long teeth on edge of upper lip, some scattered teeth behind; lower lip edentate; teeth on vomer, pterygoids, palatines and low-domed tongue. Mouth corner on vertical from anterior nostril in small fish, between anterior and posterior nostrils in larger fish; tip of upper jaw reaching vertical from midway between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner as long and as wide as the pad over the maxilla. Preorbital reaching 1/2 up upper lip, slightly above line joining midpoints of posterior and anterior nostrils; anterior nostrils wholly within vertical span of posterior nostrils; anterior nostrils closer to lip than posterior to eye. Gill rakers long, type 4.

Pectoral fin not nearly reaching eye when laid forward, c. 1/3 along pelvic fin (not nearly to tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from first dorsal fin origin than to that from origin of pectoral fin, its tip reaching vertical from base of sp. 4 of first dorsal fin or slightly before; axillary scale reaching c. 2/3 along pelvic spine. First dorsal fin origin nearer snout tip than to caudal base; sp. 1 as long as sp. 2 or slightly shorter; sp. 4 stout but short, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c. 3/4 along membrane behind sp. 4. Second dorsal fin origin on vertical from anal fin origin; tips of anterior rays not reaching behind tips of posterior rays; anal fin subequal in height to second dorsal fin, not as high as first dorsal fin; second dorsal and anal fins lightly scaled anteriorly and along base. Caudal fin somewhat lunate. Pyloric caeca 4.

DISTRIBUTION. South Africa from Walvis Bay to Durban.

REMARKS. The characteristic fold of the lower lip, obscuring the posterior end of the upper lip is shared only with *L. ramada* and *L. aurata*. The relatively short pectoral fin and the origin of the second dorsal fin being opposite the origin of the anal fin distinguish *L. richardsoni* from these 2 species. The number of pyloric caeca is also distinctive. The specimens indicated below as syntypes are presumably those described by Günther (1861b) as 'half-grown, skins'. The specimen he described as stuffed and 'type of the species' cannot be located. The only stuffed specimen in the

collection of the BMNH labelled *M. richardsoni* is also labelled 'not *M. richardsoni* Cithr type' and is *Myxus capensis* (BMNH 1848.3.31.5).

### *Liza saliens* (Risso, 1810)

*Mugil saliens* Risso, 1810: 345, Nice; 1826: 391, Nice; Bonaparte, 1834: 57, fig. 1, Italy; Valenciennes, 1836: 47(34), fig. 309, Nice; Guichenot, 1850: 67, Algeria; Günther, 1861b: 443 (part), R. Nile; Gervais & Boulenger, 1877: 196, Mediterranean; Moreau, 1881: 191, France; Carus, 1893: 707, Valencia, Algeria, Nile R.; Sucker, 1895: 46, Adriatic; Niimi, 1909: 313, Adriatic; 1913: 132, Adriatic; 1932: 1, fig., Mediterranean; Berg, 1916: 385, Russian rivers entering the Black Sea; Athanassopoulos, 1919: 267, Mediterranean; Popov, 1929: 245, Black Sea, near the Bosphorus, Danube delta; Lozano Rey, 1947: 732, fig. 189, Guadalquivir, Seville, Lore del Rio, Mar Menor, Vera Cruz; Berg et al., 1949: 546, fig. E, Atlantic, Mediterranean, Sea of Azov, Black Sea, L. Shubulat; Svetovidov, 1949: 221, figs 221-3, Black Sea; 1964: 221, figs 64-5, Black Sea; Nikolskii, 1954: 402, Mediterranean; Perlmutter et al., 1957: 297, fig. 6A-F, coast and rivers of Israel; Morovic, 1958: 62, NE Atlantic.

*Liza saliens* Popov, 1929: 245, Black Sea near the Bosphorus, Danube R. delta; Dieuzeide et al., 1955: 240, fig., Lakes of Tunis; Corsica; Klausewitz, 1958: 62, NE Atlantic; Bauchot & Pras, 1980: 300, fig. 27a, Atlantic from Morocco to the Gulf of Gascony, Mediterranean.

*Liza (Protomugil) saliens* Popov, 1930: 68, pl. 1, fig. 2, pl. 2 fig. 3, Mediterranean, Black Sea; Trewavas & Ingham, 1972: 20, Mediterranean; Tortonese, 1972: 31, Genoa, Venetian Lagoon, Naples, L. Patria, Mogora, Vassiluti, Tunis.

*Mugil (Liza) saliens* - Borcea, 1934: 275, figs 14-18, Black Sea; Oliva, 1950: 102, Bulgaria.

*Liza (Protomugil) saliens fuscata* Popov, 1930: 72, Black Sea. *Mugil (Protomugil) saliens* Cabo, 1979: 203, fig. 66, Mar Menor.

TYPE, None (see Bertin, 1945). Type locality, Nice.

MATERIAL EXAMINED. 21 specimens, 112-280mm SL from Morocco, Monaco, Italy, Thrace, Yugoslavia and Israel. BMNH: 1893.2.225, 280mm, Zara, Yugoslavia; 1927.12.2.1889, 51, 3 spec. 142-157mm, L. Borolihis; 1937.12.2.2852, 6, 5 spec. 155-172mm, L. Menzaleh; 1928.1.21.63-6, 128 & 222mm, Thrace; 1948.8.30.1, 265mm, Val Dago, Italy; 1949.9.16.487-90, 4 spec. 110-273mm, R. Naamen, Israel; 1949.11.2.36, 189mm, Monaco; 1969.1.7.22, 188mm, Naples.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9. P 16-17, L 48-49, tr. 14-15, ped. 9, pect. sc. 12-13, D<sub>1</sub> sc. 16-17, D<sub>2</sub> sc. 31-33. Scales pavement ctenoid; mucus canals long; predorsal scales multicanaliculate (2-5); occasional flank scales with double canals. Body elongate slender; head bluntly pointed, scale-free to anterior nostrils; interorbital 1.5 times eye diameter, slightly convex; eye diameter slightly longer than snout in small fish, shorter than snout in large fish. Adipose tissue rim around eye. Upper lip median height 1/5-1/4 eye diameter. Anterior pair of mandibular pores at rear of symphyseal groove, somewhat more than breadth of symphyseal knob apart; 3 other

pairs behind, much further apart. Row of fine slightly curving teeth on edge of upper lip, a similar row at inner base of lip, scattered fine teeth between; lower lip edentate; teeth on vomer, palatines, pterygoids and low-domed tongue; mouth and tongue membrane papillate. Mouth corner at vertical from between anterior and posterior nostrils; tip of upper jaw reaching vertical from between posterior nostril and anterior rim of eye. Pad over tendon to mouth corner as long and as wide as the pad over the maxilla. Preorbital reaching 2/3 up upper lip, above line joining mid-points of posterior and anterior nostrils; anterior nostrils wholly within vertical span of posterior nostrils; posterior nostril nearer eye than anterior to lip. Gill rakers short, type 4.

Pectoral fin reaching anterior rim of eye when laid forward, c. 1/2 along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin origin markedly nearer vertical from origin of pectoral fin than to that from first dorsal fin origin, its tip reaching vertical from origin of first dorsal fin in fish <120mm SL, not quite so far in large fish; axillary scale not quite reaching tip of pelvic spine. First dorsal fin origin nearer caudal base than to snout tip; sp. 1 shorter than sp. 2; sp. 4 slight, not nearly reaching vertical from tip of sp. 3 when fin raised; axillary scale reaching >1/2 along membrane behind sp. 4. Second dorsal fin origin at vertical from anal fin origin; tips of anterior rays reaching slightly behind tips of posterior rays; dorsal and anal fins about the same height; second dorsal and anal fins lightly scaled anteriorly and along base. Caudal fin deeply forked. Pyloric caeca 8.

DISTRIBUTION. Black Sea, Mediterranean and introduced into Caspian Sea (Zenkevich, 1956).

REMARKS. The only other species of *Liza* possessing multicanaliculate scales is *L. dumerili* which has fewer scales in both longitudinal and transverse series and fewer pyloric caeca.

### *Liza subviridis* (Valenciennes, 1836)

*Mugil subviridis* Valenciennes, 1836: 115(85), Malabar; Bleeker, 1853b: 48, Bengal; Günther, 1861b: 423, fig., Madras, Malabar; Day, 1865a: 138, Malabar; 1876: 353, Ganges R., 1889: 348, Seas of India; Chaudhuri, 1917: 497, Chilkil; Weber & De Beaufort, 1922: 243, Lombok, Celebes, Buri; Roxas, 1934: 408, Philippines; Jayasundaram, 1951: 23, Chilkil; John, 1955: 226, Kyanakulum L.

*Liza subviridis* McCulloch, 1929: 117, Queensland; Masuda et al., 1984: 120, pl. 347, fig. F, Japan; Shen, 1994: 439, pl. 138, fig. 3, Taiwan.

*Mugil dumerili* Valenciennes, 1836: 117(109), Bombay, Cantonment; Day, 1876: 352, pl. 74, fig. 4, Hongkong; F. in Calcutta; 1889: 347, seas of India; Head, 1907: 7, C. in



- ence Clarence R.: 1906: 42, Clarence R.; McCulloch: 1921: 126, Gold Is., Rockingham Bay, Madras; Weber & De Beaufort, 1922: 235, Singapore, Sumatra, Buitour, Banka, Borneo, Java, Bali, Lombok, Flores, Timor, Buitour, Celebes, New Guinea, Dominica Is.; Fowler, 1928a: 122, New Guinea, Indonesia, Australia; 1935: 142, fig. 55, Hong Kong; 1939a: 47, Gulf of Thailand; 1938b: 3, Saigon; Roxas, 1934: 401, pl. 1, fig. 2, Philippines, Herre, 1936b: 92, Suva; Blegvad, 1944: 183, figs 109-110, Gulf of Iran; John, 1955: 227, Kyamkulam I.; Munro, 1955: 93, pl. 16, fig. 256, Sri Lanka; 1967: 167, pl. 18, fig. 279, New Guinea; Marshall, 1964: 408, pl. 54, fig. 388, N Queensland; Pandey & Sandhu, 1992: 267, fig. 71, sea of India.
- Liza dussumieri* Thomson, 1954: 97, fig. 6, Madras, Ellice Is., Normanby Is., Shark Bay, Broome, Port Glasgow, Papua, Burdekin R., Cooktown, Gold Is., Rockingham Bay, Exmouth Gulf, Ambon; Kuranuma & Abe, 1986: 207, Kuwait market. Shen, 1994: 438, pl. 138, fig. 1, Taiwan.
- Chdon dussumieri* Taylor, 1964: 119, Arnhem Land.
- Mugil ventriosus* Richardson, 1846: 249, Canton.
- Mugil jayramis* Bleeker, 1852c: 701, Java.
- Mugil cantoris* Bleeker, 1853b: 100, pl. 1, fig. 4, Hooghly R. at Calcutta; 1862c: 80, Sumatra; Günther, 1861b: 430, Hooghly R. at Calcutta; Kner, 1865: 225, Madras.
- Mugil sundanensis* Bleeker, 1853c: 265, Sumatra; 1858c: 2, Borneo; 1859a: 276, Indonesian archipelago; 1860d: 45, Borneo; 1861c: 45, Singapore; 1863b: 271, Timor; Day, 1865: 138, Malabar; Günther, 1861b: 425, Indonesia; Macleay, 1882a: 372, New Guinea; Evermann & Seale, 1906: 506, Philippines; Jordan & Seale, 1907: 11, Luzon.
- Mugil brachysoma* Bleeker, 1855c: 399, Java.
- Mugil valenciennesi* Bleeker, 1858a: 386, Java; 1859a: 277, Indonesian archipelago.
- Mugil nepalensis* Günther, 1861b: 424, Nepal, fresh water; Osburn, 1926: 19, Hailo, Hainan.
- Mugil argentea* Günther, 1861b: 424, Northern Territory; 1877: 214, Fitzroy R., Samoa; 1881: 214, Fitzroy R., Samoa, non Quoy & Gaimard.
- Mugil meyeri* Günther, 1872: 439, Luzon, Celebe.
- Mugil jerdoni* Day, 1876: 352, India; 1889: 346, seas of India; Chaudhuri, 1917: 497, Chilka L., Whitehouse, 1927: 84, Madras; Devasundaram, 1951: 23, Chilka L.
- Mugil compressus* Castelnau, 1879: 59, Norman R., Klunzinger, 1880: 395, Darwin, Queensland; Macleay, 1880: 421, New South Wales, Port Darwin; 1884c: 269, Normanby Is. in fresh water, non Günther.
- Liza compressus* Jordan & Seale, 1906: 218, Samoa, non Günther.
- Mugil planiceps* Tsch, 1903: 2, pl. 1, fig. 3, Moreton Bay; Whitehouse, 1927: 82, Madras, non Valenciennes.
- Mugil stewarti* Ogilby, 1908: 19, Gold Is., Rockingham Bay.
- Mugil alcocki* Ogilby, 1908: 21, India.
- Mugil tadopsis* Ogilby, 1908: 27, Moreton Bay; McCulloch, 1921: 127, pl. 122, fig. 2, Moreton Bay, Burdekin R., Endeavour R.
- Mugil nathani* Fowler, 1918: 3, fig. 1, Philippines; Roxas, 1934: 409, Philippines.
- Mugil ogilbyi* Fowler, 1918: 5, fig. 2, Philippines; Roxas, 1934: 412, Philippines.
- Mugil philippinus* Fowler, 1918: 7, fig. 3, Philippines.
- Mugil philippinus* Roxas, 1934: 409, Philippines.
- Mugil lepidopterus* Fowler, 1918: 9, fig. 4, Philippines; Roxas, 1934: 402, Philippines.
- Mugil medius* Machan, 1931: 221, Borneo.
- Moolgarda pura* Whitley, 1945: 15, fig. 3, part, Pt Claines, Shark Bay, Onslow, Broome.
- Oxyommil acutus* Whitley, 1948: 272, fig. 7, WA.
- Mugil passia* Pillay, 1962: 553, part, Bombay, Madras, Chilka L., Travancore, non Hamilton Buchanan.
- TYPE. Syntypes: Bombay, MNIN A.3649, Pondicherry, A.3650, A.3651, Dussumier.
- MATERIAL EXAMINED. 4 syntypes and 94 specimens, including the types of *M. nepalensis*, *M. meyeri*, *M. dussumieri*, *M. sundanensis*, *M. brachysoma*, *M. valenciennesi*, *M. cantoris*, *M. pura*, *M. stewarti* and *M. tadopsis*, 39 282mm SL from Pakistan, India, Malaya, Indonesia, Australia, Taiwan, Philippines and Samoa. BMNH: 1847.11.22.141, 64mm, Madras; 1853.8.16.25, 176mm, holotype of *M. nepalensis*, Nepal, Hodgson; 1858.10.19.69, 155mm, Ceylon; 1860.3.19.869, 115mm, Karachi; 1867.5.6.29-30, 188 & 195mm, Cape York; 1872.3.12.25-6, 153 & 158mm, syntypes of *M. meyeri*, Makassar, Meyer; 1872.10.18.3m 145mm, Laguna del Rey, Luzon, 1873.1.21.4, 229mm, Fitzroy R., Queensland; 1887.4.18.3, 144mm, Samoa; 1880.4.21.162-3, 163 & 168mm, labelled 'syntypes of *Mugil aculeatus* coll Bleeker', Indonesia; 1884.5.15.19, 103mm, Taiwan; 1899.2.1.3687-8, 58 & 60mm, Orissa; 1889.2.1.3692-3, 92 & 109mm, Madras; 1889.2.1.3713, 126mm, Sind; 1889.2.1.3768, 99mm, Karachi; 1889.2.1.3769-73, 5 spec. 39-46mm, Calcutta; 1889.2.1.3776, 80mm, Madras; 1913.12.9.88-93, 6 spec. 92-135mm, Goram; 1920.3.3.257-267, 20 spec. 110-238mm, Basra; 1933.4.11.729, 179mm, Cebu; 1934.9.11.33-4, 17 & 18mm, Lantao Is. Malaya MNIN: A 3649, 140 & 142mm, syntypes of *M. salweeni* Bombay, Dussumier; A.3650, 145mm, syntype of *M. salweeni*, R. Ganges, Dussumier; A.3651, 108mm, syntype of *M. subcylindricus*, Pondicherry Dussumier; A.3634, 3 spec. 160-190mm, syntypes of *M. dussumieri*, coasts of Coromandel Dussumier; A.3723, 3 spec. 65-66mm, Nicol Bay; A.2000, 200mm, Manila. RMNH: 6387, 8 spec. 150-216mm, syntypes of *M. sundanensis* and holotype of *M. brachysoma*, Sind, Bleeker; 6389, 3 spec. 105-145mm, syntypes of *M. valenciennesi*, Java, Bleeker; 6402, 3 spec. 55-103mm, syntypes of *M. cantoris*, Bengal, Bleeker. AM: B.7967, 144mm, labelled '*M. jerdoni* Day', type Bombay coll. Day; L.13225, 282mm, syntypes of *M. pura*, Shark Bay, Whitley; L.18127, 188mm, Burdekin R.; L.18901, 222mm, Shark Bay; B. 1660, Derby. QM: 1774, 131mm, holotype of *M. stewarti*, Gold Is., Rockingham Bay, Stevens; L.1570, 229mm, holotype of *M. tadopsis*, Moreton Bay, Ogilby.
- DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III (8)9, P I 5 I 1 1 27-32, tr 11, ped. 7, pect. sc. 7, D<sub>1</sub> sc. 10-11, D<sub>2</sub> sc. 20. Scales pavement ctenoid; mucus canals of moderate length; variable number of scales with 2 or 3 canals, some with T- or Y-shaped canals, mostly dorsally, but sometimes on flanks. Body moderately robust; head bluntly pointed, scale-free to anterior nostril; interorbital slightly less than twice eye diameter, gently convex; eye diameter longer than snout. Adipose tissue covering iris. Upper lip median height c.1/3 eye diameter. Anterior pair of mandibular pores at rear of symphyseal groove, about breadth of symphyseal knob apart; larger pair behind, followed by 3 obscure pairs. Small fine teeth along edge of upper lip with several rows behind, better developed in large fish; ciliiform teeth in lower lip, often missing in larger fish; no teeth on vomer and palatine, but teeth on pterygoids and high-keeled tongue. Row of low papillae with long axes parallel to lip edge at inner base of lower lip. Mouth corner at vertical just behind anterior nostrils; tip

of upper jaw reaching vertical from anterior rim of eye. Pad over tendon to mouth corner c. 2/3 length and 1/2 width of pad over maxilla. Preorbital reaching c. 3/4 up upper lip, above line joining midpoints of posterior and anterior nostrils; c. 50% of anterior nostrils below vertical span of posterior nostrils; nostrils equidistant from lip, eye and each other in some specimens; in other fish nearer to each other than to lip and eye. Gill rakers short, type 4.

Pectoral fin reaching posterior edge of pupil when laid forward, c. 1/3 along pelvic fin (not nearly to end of pelvic spine) when laid back. Pelvic fin origin nearer vertical from origin of pectoral fin than that from first dorsal fin origin, its tip reaching vertical from base of sp. 2 of first dorsal fin; axillary scale reaching c. 1/2 along pelvic spine. First dorsal fin origin nearer snout tip than caudal base; sp. 1 longer than sp. 2; sp. 4 weak, not reaching past vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical 1/3-1/2 along base of anal fin; tips of anterior rays reaching behind tips of posterior rays; anal and first dorsal fins subequal, higher than second dorsal fin; second dorsal and anal fins densely scaled. Caudal fin moderately forked. Pyloric caeca 4 or 5.

DISTRIBUTION. N Indian Ocean to W Pacific, from Persian Gulf to N Australia, Taiwan and Samoa.

REMARKS. This is one of 6 species of *Liza* that have a well-developed adipose eyelid in the adult. Its absence in young fish is one factor contributing to the large synonymy of this species, as some authors have failed to connect the lid-less phase with the adult. *L. subviridis* differs from the other 5 species in having the mouth corner reaching back only as far as the vertical from the anterior nostril. The species has no outstanding physical features and deserves Macan's (1931) name of *medius*. Valenciennes (1836) differentiated *L. dussumieri* from *L. subviridis* on the anal fin ray count which he gave as 8 for the former species and 9 for the latter; but the type specimens of each have 9. Among the 1001 specimens examined 2 had 8 anal rays, but these differed in no other way from typical *L. subviridis*. The 2 must be regarded as one, as Day (1878) suspected long ago. *L. subviridis* is regarded as the valid name on page priority. The type specimens of *M. brachysoma*, *M. valenciennesii*, *M. meyeri*, *M. cantoris*, *M. nepalensis*, *M. stevensi* and *M. tadopsis* all proved to be indistinguishable from *L. subviridis*. Of the 4 syntypes of *M. jerdoni* in the British Museum, 3 agree with *L. subviridis* in all respects.

but the fourth is *L. macrolepis*. Besides these and the specimen from the Australian Museum, specimens from Day's collection exist in other museums, including the Calcutta Museum (Whitehead & Talwar, 1976). Fowler (1928b) recognised that *M. philippinus*, *M. ruthveni* and *M. lepidopterus* were all synonyms of *L. subviridis*. Ogilby (1908) proposed *M. alcocki* for specimens of *L. subviridis* that had 8 anal rays. The other species listed in the synonymy are regarded as synonyms on the basis of their published descriptions. The position of *Moolgarda puri* Whitley has been discussed by Thomson (1954) and is elaborated upon in the discussion of *Liza* above. Fowler (1928a) referred *M. anpinensis* Oshima to *L. argentea*, but the scale counts are not compatible. Oshima's description is inadequate for certain identification, but it is not inconsistent with *L. subviridis*.

### *Liza tade* (Forsskal, 1775)

*Mugil crenulatus* Tade Forsskal, 1775: 74, Arabia; Bloch & Schneider, 1801: 116, Red Sea.

*Mugil tade* Valenciennes, 1836: 153 (114), Red Sea; Klunzinger, 1870: 828, Red Sea; 1880: 395, Cleveland Bay; 1884: 132, pl. 10, fig. 3, Red Sea; Madeay, 1885: 40, Cleveland Bay; Day, 1888: 350, Hooghly R.; 1889: 344, Hooghly R.; Weber & De Beaufort, 1922: 236, Singapore; Sumatra, Sinalur, Banka, Java, Maura, Lombok, Bali, Borneo, Celebes, New Guinea, Fowler, 1928a: 122, fig. 20, Apetaku, Guam; 1935: 139, China; 1938b: 120, 121, 276, Tuamotu, Rongaroa; Roxas, 1934: 403, Philippines; Pietschmann, 1939: 184, fig. 2, Red Sea; Devasundaram, 1951: 21, Chilka L.; John, 1955: 227, Kvarnkulam L.; Pillay, 1962: 556, pl. 1, fig. 4, Calcutta, Chilka L.; Marshall, 1964: 409, pl. 155, fig. 389, N Queensland.

*Liza tade* Munro, 1955: 93, pl. 16, fig. 257, Ceylon.

*Mugil planiceps* Valenciennes, 1836: 122 (90), Calcutta, Bengal; Bleeker, 1853b: 101, pl. 1, fig. 51, Bengal, Gunther, 1861b: 428, Calcutta, Ceylon, Hindustan, Penang, Bengal, China; Kner, 1865: 225, Java, Ceylon; Day, 1876: 350, Hooghly R. at Calcutta, Malaya, China; Seale, 1901: 66, Guam; 1914: 61, Hong Kong; Evermann & Seale, 1906: 59 Philippines; Whitehouse, 1927: 82, Tuticora.

?*Mugil cephalotus* Cantor, 1850: 1077, Penang, non Valenciennes.

*Mugil bontas* Bleeker, 1853b: 46, Bengal; nomen nudum; 1857c: 336, Java; 1859a: 278, Indonesian archipelago; 1859b: 407, Japan; 1859c: 367, Banka; 1860c: 33, Sumatra, 1862d: 40, Borneo; 1861e: 54, Singapore; 1865b: 174, Thailand.

*Mugil lularak* Bleeker, 1857c: 357, Java; Gunther, 1861b: 427, Java; Day, 1876: 351, pl. 74, fig. 5, Bombay; 1889: 345, Bombay; Vinciguerra, 1890: 180, Burma; Fowler, 1905: 494, fig. 1, Borneo; Pandey & Sandhu 1992: 266, Bombay, India to Malay Archipelago.

(?) *Mugil dussumieri* Bleeker, 1857: 339, Java; 1860c: 35, Sumatra; 1860d: 49, Borneo, non Valenciennes.

*Mugil poecilus* Day, 1865a: 140, Malabar; 1865b: 33, pl. 19, Cochin; 1876: 351, pl. 75, fig. 4, Bombay, W coast of India; 1889: 345, India; John, 1955: 227, Kvarnkulam L.; Pandey & Sandhu, 1992: 267, Bombay, W coast of India.

TYPE. Name. Type locality, Arabia.

MATERIAL EXAMINED. 44 specimens, including the types of *M. poecilus*, *M. planiceps*, *M. belanak* and *M. bontab*, 16-316mm SL, from both coasts of India, Ceylon, Malaya and Indonesia. BMNH: 1954.3.21.25, 147mm, Ceylon; 1860.3.19.367-70, 4 spec. 135-173mm, labelled 'Syntypes of *M. belanak*, Jakarta, Bleeker'; 1864.1.19.8, 125mm, holotype of *M. poecilus*, Cochlin Day; 1889.2.1.3694, 152mm, Cannanore; 1896.10.13.30, 190mm, Calcutta; 1900.2.2.34, 167mm, Madras; 1911.8.23.9, 190mm, Sarawak; 1972.7.25.1-13, 13 spec. 18-28mm, Erhina R., Socotra. MNHN: A.3647, 285mm, syntype of *M. planiceps*, Bengal, Belanger; A.3648, 100 & 143mm, syntypes of *M. planiceps*, Bengal, Belanger; A.3659, 153 & 165mm, syntypes of *M. planiceps*, Calcutta, Dussumier. RMNH: 6388, 6 spec. 130-201mm, syntypes of *M. belanak*, Jakarta, Bleeker; 6488 (same par as *M. belanak*), 254 & 310mm, syntypes of *M. bontab*, Jakarta, Bleeker.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 15-17, 11/31-35, tr. 11, ped. 7, pect. sc. 8-9, D<sub>1</sub> sc. 9-10, D<sub>2</sub> sc. 20-21. Scales pavement ctenoid, posterior field unusually long; mucus grooves long, extending well into posterior field; some specimens with 2 or 3 canals on anterodorsal and more rarely flank scales. Body slender, elongate; head pointed, upper profile depressed, scale-free to anterior nostrils; interorbital twice eye diameter, flat; eye diameter equal to snout in fish under 150mm SL, <snout in larger fish. Adipose tissue covering most of iris. Upper lip median height 1/4-1/5 eye diameter. Anterior mandibular pores at rear of symphyseal groove about breadth of symphyseal knob apart; 4-5 pairs of pores behind. 5-9 rows of small, almost straight teeth in upper lip; single row of sparse ciliiform teeth in lower lip; teeth on vomer, palatines, pterygoids and high-keeled tongue; row of broad papillae with long axes transverse to edge at inner base of lower lip; abundant fine papillae on mouth membrane. Mouth corner at vertical from posterior nostril; tip of upper jaw reaching vertical between posterior nostril and anterior rim of eye; pad over tendon to mouth corner visible only in large fish. Posterior end of preorbital curving up sharply, anterior end reaching 1/2 up upper lip, above line joining midpoints of posterior and anterior nostrils; anterior nostrils entirely below vertical span of posterior nostrils; nostrils equidistant from each other and from eye and lip. Gill rakers moderately long, type 4.

Pectoral fin reaching posterior eye in small fish, not to eye in larger, when laid forward. 1/3-1/2 along pelvic fin (not reaching tip of pelvic spine) when laid back. Pelvic fin origin equidistant from vertical from origin of pectoral fin and that from first dorsal fin origin, its tip reaching vertical from base of sp. 3 of first dorsal fin; axillary scale not reaching tip of pelvic spine. First dorsal fin origin nearer snout tip than to caudal

base or equidistant; sp. 1 shorter than sp. 2; sp. 4 weak, not reaching past vertical from tip of sp. 3 when fin raised. Second dorsal fin origin at vertical > 1/2 along anal fin base; tips of anterior rays reaching well behind tips of posterior rays; dorsal and anal fins approximately equal in height; second dorsal and anal fins densely scaled. Caudal fin moderately forked. Pyloric caeca 5.

DISTRIBUTION. N Indian Ocean to W Pacific, from Red Sea to tropical Australia, New Hebrides and Philippines.

REMARKS. The depressed pointed head is characteristic of this species. It is similar to *L. subviridis* and *L. parsi*, sharing with them the well-developed adipose eyelid, similar scale counts, fin ray numbers and number of pyloric caeca. The relatively small size of the eye and slight median height of the upper lip are also characteristic of *L. tade*. All 3 species have a deep caudal peduncle, but relative to body depth that of *L. tade* is the greatest. The species recognised by Klunzinger (1870) and by subsequent authors as *Mugil tade* is the same as that named *M. planiceps* by others. Valenciennes regarded Forsskal's description as inadequate, as it undoubtedly was, but not more than most descriptions of the time. There has been some reluctance to accept Forsskal's name on the ground that his nomenclature was not binominal. He certainly used both binominal and trinominal names. Whether his trinominal names can be accepted as subspecific indications is disputable, but if this possibility is accepted then raising the subspecific name 'tade' to specific status would be a valid procedure. Unfortunately there is confusion about the extant type specimens believed to be those of Forsskal. Trewavas & Ingham (1972) provided evidence that the labelling indicated by Klauswitz & Nielsen (1965) does not conform with information provided earlier by Dr Pfaff of the Copenhagen Museum where Forsskal's types were deposited. Klauswitz & Nielsen provided photographs and x-ray pictures of the remaining types with some brief biometric data, none of which give any assurance that 1 of the remaining skins might be the original of *M. crenilabris tade*. The types of *M. bontab*, *M. belanak* and *M. poecilus* represent growth stages of *L. tade* and exhibit no features to differentiate them. Pillay (1953) suggested that *M. poecilus* is identical with *L. troschelti* which is here referred to *M. macrolepis*. However Day's specimens of *M. poecilus* in the British Museum are *L. tade*, not *L. macrolepis*. Besides the British Museum specimens others supplied by Day exist in 6 museums (Whitehead & Talwar, 1976). It is uncertain which made up the original material

but the 'type' listed from the British Museum is from the type locality.

### *Liza tricuspidens* (Smith, 1935)

*Mugil capensis* Smith, 1849: pl. 30, fig. 1, Cape of Good Hope; Bleeker, 1860f: 69, Cape of Good Hope, non Valenciennes.

*Mugil tricuspidens* Smith, 1935: 618, fig. 10, pl. 17, fig. A, Mossel Bay, Knyana, Zwartkops R., Buffalo R., Mazeppa Bay, Durban.

*Heteromugil tricuspidens* Smith, 1948: 837, fig. 7, Mossel Bay to Durban; 1949: 320, fig. 882, Mossel Bay to Durban.

TYPE. None. Type locality, Cape of Good Hope.

MATERIAL EXAMINED. 5 specimens, 152-330mm SL, from Angola, Cape of Good Hope and Natal. BMNH: 1848.2.1.2., 268mm, Cape of Good Hope; 1905.2.24.4, 152mm, Angola; 1916.1.18.2, 330mm, Knyana; 1922.1.13.26, 242mm, Durban; 1935.3.27.3, 230mm, Knyana.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 17-18, L1 42-44, tr. 14-15, ped. 9, pect. sc. 11, D<sub>1</sub> sc. 15, D<sub>2</sub> sc. 28. Scales pavement ctenoid, mucus canals narrow, moderately long; some dorsal and fewer flank scales with double or branching canals. Body robust, head bluntly pointed, scale-free to anterior nostrils; interorbital less than twice eye diameter in small fish equalling twice eye diameter in large, slightly convex; eye diameter not quite as long as snout. Adipose tissue rim around eye. Upper lip median height  $>1/3$  eye diameter. Anterior mandibular pores at rear of symphyseal groove, c. breadth of symphyseal knob apart; tricuspid teeth on edge and at inner base of upper lip, scattered teeth between; lower lip edentate; unicuspid teeth on vomer, pterygoids and tongue, but none on palatines; tongue with slight median ridge. Mouth corner at vertical from anterior nostrils; tip of upper jaw reaching vertical behind posterior nostril. Pad over tendon to mouth corner equal in length but  $1/2$  width of pad over maxilla. Preorbital reaching c.  $1/2$  up upper lip, on line joining midpoints of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior nostril; nostrils nearer each other than to lip or eye. Gill rakers moderately long, type 3.

Pectoral fin reaching hind rim of eye in fish up to 150mm SL and to anterior rim of eye by 300mm when laid forward,  $<1/2$  along pelvic fin (not past tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from pectoral fin origin than that from origin of first dorsal fin, its tip reaching vertical between bases of sp. 1 and sp. 2 of first dorsal fin; axillary scale reaching c.  $1/2$  along pelvic spine. First dorsal fin origin equidistant from snout tip and caudal base: sp. 1 equal to sp. 2 or slightly shorter; sp. 4 elongate, reaching behind vertical from tip of sp. 3 when fin raised;

axillary scale reaching  $1/2$  along fin membrane behind sp. 4. Second dorsal fin origin at vertical between anal fin origin and  $1/4$  along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin higher than second dorsal fin and both higher than first dorsal fin; second dorsal and anal fins falcate, densely scaled. Caudal fin lunate. Pyloric caeca 6.

DISTRIBUTION. South Africa from Angola to Durban.

REMARKS. The tricuspid teeth distinguish this species. The skin (BMNH 1848.2.1.1), identified by A. Smith, as *M. capensis* shows such teeth.

### *Liza vaigiensis* (Quoy & Gaimard, 1824)

*Mugil vaigiensis* Quoy & Gaimard, 1824: 337, pl. 59, fig. 2, Waigiu. Bleeker, 1859a: 276, Indonesian archipelago; 1860a: 203, Karanbollong; 1860b: 417, Batjan; 1860c: 35, Sumatra; 1860d: 43, Borneo; 1862: 110, Batjan; Peters, 1876b: 842, Bougainville; Duncker, 1904: 166, Singapore; Boulenger, 1916: 97, fig. 54, Red Sea; Fowler, 1927a: 8, Christmas Is., Palmyra Is.; 1927b: 264, Philippines; 1928a: 124, fig. 7, Rarotonga, Guam, Mangrove, Raitoa, Tuamotus, Faté, Apia, Funafuti, Tonga, Makemo, Tongatabu, Suva, Rangirotu, Marshall Is., Moen, Society Is., Kingsmill Is.; 1932a: 444, Singapore; 1935: 145, Hong Kong; Pellegrin, 1933: 180, fig. 98, Madagascar, in fresh water; Roxas, 1934: 410, Philippines; Schultz, 1943: 79, Samoa; Scott, 1959: 121, Malaya; Pillay, 1962: 561, pl. 2, fig. 2, Akyah, Bombay, Madras, Pamban, Marshall, 1964: 410, col. pl. 55, Queensland.

*Mugil vaigiensis* Bleeker, 1859c: 368, Banka; 1859d: 331, Java; 1861b: 101, Singapore; 1861c: 55, Singapore; 1861d: 76, Penang; Günther, 1861b: 435, fig. 9, Red Sea, Penang, Indonesia, Northern Territory, Polynesia; 1877: 216, pl. 121, fig. B, Tahiti; 1880b: 62, Cape York; Kner, 1865: 226, Red Sea; Day, 1865a: 144, Malabar; 1876: 359, pl. 73, fig. 4, Bombay, Red Sea, India, Malaya; 1889: 356, Red Sea, India, Malaya, Klunzinger, 1870: 828, Red Sea; 1880: 393, Port Dennison; 1884: 133, pl. 10, Red Sea; Peters, 1876b: 842, Bougainville Is.; Macleay, 1880: 423, New South Wales; 1882a: 362, New South Wales; 1884b: 207, Burdekin R., Queensland; Sauvage, 1891: 401, pl. 41B, fig. 5, Madagascar; Seale, 1901: 65, Guam; Stead, 1906: 1416, Samoa; Stead, 1906: 79, Queensland and N New South Wales; 1907: 7, Ballina, Rockhampton, Cleveland B.; 1908: 42, Ballina; Jordan & Seale, 1907: 11, Luzon; Weber & De Beaufort, 1922: 244, Singapore, Pulu Weh, Sumatra, Bintang, Banka, Java, Madura, Timor, Konglang Is., Paternoster Is., Flores, Gorang, Amboin, Batjan, New Guinea, Waigiu, Cocos, Kerling; Barnard, 1925: 310, Natal, Delagoa Bay; Chinde; Paradise & Whitley, 1927: 81, Pellew Is., Smith, 1935: 633, fig. 16, pl. 20 Chinde, Delagoa Bay.

*Liza vaigiensis* Jordan & Seale, 1906: 218, Samoa. Herre, 1946b: 95, Marae, Suva, Nukunono, Malaita; Schultz, 1943: 81, Canton Is., Swan Is., Tutulia; Thomson, 1954: 103, fig. 6, Burdekin R., Cape York, Cooktown, Wide Bay, Cleveland Bay, Cumberland Is., Brampton Is., Liridenan Is., Nor-west Is., Low Is., Richmond R., at Gloucester, Darwin, Port Moresby, Madras, Guadalcanal, Ellice Is., Nauru, Vanikoro; Munro, 1967: 167, pl. 18, fig. 276, New Guinea; Masuda et al. 1984: 120, pl. 109, fig. K, Japan; Pandey & Sandhu, 1992: 278, Red Sea to China and beyond.

- Liza vaigiensis* Seale, 1906: 15, Mangareva, Farø, Raatea, Shonland Is., Raratonga; 1935: 355, Cleveland Bay, Ren-nel Is.; Whitehouse, 1927: 95, Tuticorn.
- Mugil (Liza) vaigiensis* McCulloch & Whitley, 1925: 141, Queensland.
- Eleutheron vaigiensis* Whitley, 1930: 257, Waigiu; 1934: 346, Princess Charlotte Bay, Smith, 1948: 838, fig. 8, Indo-Pacific to Durban; 1949: 320, fig. 833, tropical Indo-Pacific to Durban; Fourmanoir, 1957: 72, Madagascar.
- Chelon vaigiensis* Schultz, 1953: 831, pl. 23B, 24C, Bikini, Rongelap, Guam; Taylor, 1964: 722, Arothem Land.
- Valamugil vaigiensis* Smith, 1956: 722, Aldabra.
- Mugil macrolepidotus* Rüppell, 1828: 140, Red Sea; Valenciennes, 1836: 134(99), Waigiu, Bora Bora, Vanicoro; Richardson, 1846: 249, China; Cantor, 1850: 1077, Malaya; Jouan, 1861: 308, New Caledonia; 1867: 244, Hong Kong.
- Mugil melanochir* Valenciennes, 1836: 143(106), Java, Guam; Bleeker, 1852c: 423, Borneo; 1852d: 445, Banka; 1853b: 48, Bengal; 1857d: 479, Java.
- Mugil tegeban* Thollière, 1856: 415, Woodlark Is.; 1857: 184, Woodlark Is.
- Mugil occidentalis* Castelnau, 1873b: 135, Port Phillip, rivers of Western Australia; Macleay, 1880: 419, Western Australia.
- Mugil deluatus* Jouan, 1878: 333, New Caledonia, non Alleyne & Macleay.
- Mugil rossii* Bleeker, 1854c: 45, Cocos Is.; 1859a: 276, Indonesia; 1860d: 42, Borneo.
- Mugil rosi* Weber, 1913: 138, Sonek, Waigiu, Sarong.

**HOLOTYPE.** MNHN A.3641; Waigiu Is., Quoy & Gaimard.

**MATERIAL EXAMINED.** Holotype and 71 specimens, including the types of *M. macrolepidotus*, *M. melanochir*, *M. occidentalis*, *M. ventriosus* and *M. rossii*, 10-475mm SL, from Madagascar, Red Sea, Pakistan, India, Andaman Islands, Burma, Malaysia, Indonesia, Australia, Fiji and Philippines. BMNH: 1845.10.29.77, 2 spec. 122mm, Red Sea, labelled 'syntypes *Mugil macrolepidotus* Rüppell'; 1848.3.18.36; 86mm, NW Australia; 1858.4.21.472, 87mm, locality unknown; 1860.3.19.362, 240mm, Penang; 1860.11.9.86-90, 5 spec. 62-118mm, Red Sea; 1872.4.6.13-14, 83 & 115mm, N Celebes; 1873.4.3.75, 154mm, Tahiti; 1872.4.6.13, 363mm, Tahiti; 1879.5.14.494, 57mm, Cape York; 1883.11.29.67-9, 3 spec. 268-290mm, NSW; 1889.2.1.3764, 180mm, Bombay; 1889.2.1.3765, 78mm, Akyab; 1889.2.1.3766, 94mm, Andaman Is.; 1890.9.23.97, 335mm, Fraser Is.; 1894.8.3.34, 330mm, Karachi; 1898.11.8.109, 37mm, Koh Kram, Gulf of Thailand; 1933.3.11.741-3, 4 spec. 39-48mm, Kanglewai Is.; 1949.11.29.562-4, 3 spec. 458-475mm, outer lagoon, Cocos-Keeling; 1960.3.15.1706-8, 3 spec. 49-52mm, Marsa Sheik Ibrahim, Sudan. MNHN: A.843, 125mm, syntype of *M. macrolepidotus*, Red Sea, Rüppell; A.844, 68mm, holotype of *M. melanochir*, Java Kuhl & van Hasselt; A.2285, 3 spec. 105-118mm, Sulu; A.3566, 82 & 100mm, Conson Is., Vietnam; A.3623, 150mm, Vanikoro; A.3625, 220mm, Bombay; A.3630, 65mm, paratype of *M. melanochir*, Guam, Quoy & Gaimard; A.3636, 91mm, Bombay; A.3640, 228mm, Red Sea; A.3641, 215mm, holotype of *M. vaigiensis*, Waigiu; A.3654, 3 spec. 71-72mm, syntypes of *M. occidentalis*, Dampier Archipelago, Castelnau; A.3655, 3 spec. 74-92mm, syntypes of *M. occidentalis*, Dampier Archipelago, Castelnau; A.3658, 112mm, Bora Bora; A.3725, 3 spec. 65-68mm, syntypes of *M. ventriosus*, Nicot Bay. RMNH: 1641, 83mm, Borneo; 6397, 210mm, holotype of *M. rossii*, Cocos Is.

**DESCRIPTION.** D<sub>1</sub> IV, D<sub>2</sub> i 8 A III 8, P. 17, L1 24-26, tr 8, ped 7, pect. sc. 8, D<sub>1</sub> sc. 9, D<sub>2</sub> sc. 18.

Scales pavement ctenoid, mucus canals long, slender, reaching well into posterior field; some anterodorsal and fewer flank scales of some specimens with 2 or 3 canals. Body robust; head bluntly pointed, scale-free to between anterior and posterior nostrils; interorbital more than twice eye diameter, flat; eye diameter slightly longer than snout. Adipose tissue rim around eye. Upper lip median height c.1/4 eye diameter. Anterior mandibular pores at rear of symphyseal groove, about breadth of symphyseal knob apart; other pores obscure. 1-2 rows of short straight unicuspid teeth along upper lip, lost in fish >250-300mm SL; single row of rather long ciliiform teeth in lower lip; teeth on vomer, palatines, pterygoids and domed tongue; all subject to loss. Row of broad stalked papillae at inner base of lower lip; mouth membrane with fine pointed papillae. Mouth corner at vertical from posterior nostril; tip of upper jaw reaching vertical from anterior rim of eye in small fish, somewhat further forward in large. Pad over tendon to mouth corner about as wide as pad over maxilla but only 1/2 as long. Preorbital lower edge curving up posteriorly, front reaching 1/2 up upper lip, above line joining midpoints of posterior and anterior nostrils; anterior nostril wholly within vertical span of posterior nostril; nostrils nearer each other than to lip or eye. Gill rakers short, type 3.

Pectoral fin reaching anterior 1/3 of eye when laid forward, c.2/3 along pelvic fin (just past tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from origin of pectoral fin than to that from first dorsal fin origin, tip reaching vertical c.1/2 along membrane behind sp. 4 of first dorsal fin; axillary scale reaching c.3/4 along pelvic spine. First dorsal fin origin nearer caudal base than to snout tip; sp. 1 shorter than sp. 2; sp. 4 weak, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second dorsal fin origin at vertical c.2/3 along anal fin base; tips of anterior rays reaching well behind tips of posterior rays; anal fin slightly higher than second dorsal fin, and both higher than first dorsal fin; second dorsal and anal fins densely scaled. Caudal fin only very slightly excavate. Second dorsal, anal and caudal fins edged with black. 5 dusky pigment splotches along flanks. Pyloric caeca 14-16.

**DISTRIBUTION.** Indo-Pacific from Natal to Tahiti.

**REMARKS.** The almost straight tailing edge to the caudal fin is distinctive. The only species of *Liza* which share such a low longitudinal scale

count are *L. grandisquais* and *L. luciae* which both have distinctively forked tails. Examination of the types listed above confirm the conspecificity of all the species listed except for *M. legobuan* and *M. delicatus* which are judged to be *L. vaigiensis* from their descriptions.

### *Chelon* Artedi, 1793

*Chelon* Artedi, 1793: 118; type species *Mugil chelon* Cuvier, 1829.

**DIAGNOSIS.** Mouth gape almost horizontal; mid-gape at mid-pupil or slightly above; mouth corner at level of lower half of pupil, not reaching as far back as vertical from anterior nostril. Tip of upper jaw well below line of gape, reaching vertical from posterior nostril. Upper lip terminal, high, its lower 1/3 with several rows of enlarged papillae, apparent only in specimens >100mm SL. Lower lip thin-edged, thickening with age, not turning down, without folds, crenulations or papillae. High double symphyseal knob, no lip groove. No fleshy lobes over ends of jaws or lying freely between rami of lower jaw; lower jaw only slightly curving. Maxilla slightly mobile, tendon flange 2/3 or more down shaft, below level of mouth; shaft curving in 2 planes below flange to S-shaped ending; maxilla not visible above premaxilla, but visible below mouth corner when mouth closed. Mandibular angle obtuse. Upper lip with labial teeth in 2 rows with scattered teeth between; lower lip edentate; teeth on vomer, pterygoids and tongue, but none on palatines; high median keel on tongue. Adipose tissue intruding only slightly over iris. Preorbital notched, filling space lip to eye. Posterior nostril not reaching above level of upper rim of eye; nostrils nearer each other than to lip or eye; anterior nostril wholly within vertical span of posterior nostril.

Upper insertion of pectoral fin at level of upper rim of eye or slightly below; axillary scale absent or rudimentary; tip of pectoral fin not reaching vertical from origin of first dorsal fin; pelvic fin origin nearer vertical from pectoral fin origin than to that from origin of first dorsal fin. First dorsal fin origin variably placed relative to snout tip and caudal base; second dorsal fin origin between verticals from 1/4 and 1/2 along anal fin base. 3 anal spines in adult; caudal fin deeply forked; scales pavement ctenoid or cycloid. No spine on edge of operculum. Stomach with gizzard; intestines 5-7 times SL. Pyloric caeca 5-7.

**REMARKS.** The lip papillae differ from the ornamentation of *Crenimugil* and *Oedalechilus*.

The crenulations at the mouth corner, typical of *Crenimugil*, are not found in *Chelon*. Although the preorbital of *Chelon* is notched, its depth does not approach that of *Oedalechilus*. In its general features such as in the exposed maxilla pad and the rudimentary pectoral scale *Chelon* is close to *Liza*, whereas *Crenimugil* with the membranous edges to its scales and the long pointed axillary scales, is close to *Valamugil*. *Oedalechilus* also has an exposed maxilla pad, but differs from *Chelon*, not only in the nature of the lip ornamentation but also in having a much more mobile maxilla, a flat tongue and no teeth. In attributing *Chelon* to Artedi the views of Cohen (1971) on the status of the 1793 edition of Artedi are accepted. Rose, to whom the genus has been attributed by Schultz (1946) and others, was only the publisher of the work. Wahlbaum revised the text by means of footnotes, but had not reached volume IV, in which the mullets are included, by publication date. Rose simply reprinted Artedi's text of this volume. Trewavas & Ingham (1972) pointed out that there are indications that Artedi confused *Chelon labrosus* (his *Chelon chelon*) and *Oedalechilus labiosus* in his monospecific genus, but this in itself does not preclude acceptance of the generic name. My generic concept is restricted by comparison with that of Schultz (1946).

### KEY TO THE SPECIES OF *CHELON*

1. Pectoral fin reaching eye when laid forward; first dorsal fin origin nearer snout tip than to caudal base (Mediterranean to E Atlantic N of Cape Verde)

*labrosus*

- Pectoral fin reaching posterior nostril when laid forward; first dorsal fin origin nearer caudal base than to snout tip (Cape Verde Is.) . . . . . *luspansus*

### *Chelon labrosus* (Risso)

*Mugil cephalus* var. *B* Delaroche, 1809: 32, pl. 2, fig. 7, Aegean Sea.

*Mugil cephalus* Risso, 1810: 345, Nice, non Linnaeus.

*Mugil labrosus* Risso, 1826: 389, Nice; Chevey, 1929: 337 fig. 1, 2, France, Atlantic coast; Arné, 1938: 92, fig. 10, Gulf of Gascony; Joubin, 1938: 337, figs. Mediterranean; Atlantic: North Sea to Canary Is. Poll, 1947: 319, fig. 203, Belgium; Dantec, 1955: 95, pl. 1, figs 4-5, Arcachon; Bănărescu, 1964: 184, Black Sea, Roumanian coast; Svetovidov, 1964: 212, fig. 2, Black Sea.

*Liza labrosus* Buen, 1958: 95, fig. 2, Spain, Drazuelo, c. 1930: 242, fig. 1, Algeria.

*Chelon labrosus* Dancker & Ladiges, 1967: 287, Northmark, Heligoland Bight; Trewavas & Ingham, 1972: 17, Mediterranean; Lonnese, 1971: 32, Genoa, Camogli, Venetian lagoon, Naples, L. Patria, Messina, Bari, Dalmatian; Bouchon & Pras, 1980: 122, fig. 26c, North Atlantic to Iceland; Mediterranean.

*Mugil Labrosus labrosus* Blanc & Bănărescu, 1968: 77, European rivers in fresh water.



*Mugil (Chelon) labrous* Cuvier, 1979: 211, fig. 75, Mar Menor.

*Mugil labrous septentrionalis* Blanc & Bănărescu, 1968: 27, European rivers.

*Crenimugil labrous* Wheeler, 1969: 464, fig. 315, Britain, Mediterranean, North Sea, Norway, Iceland; Hickling, 1970: 609, Britain.

*Mugil chelo* Cuvier, 1829: 232, Abbeville, Brest, Lorient, La Rochelle, Marseilles, Sicily; 1830: 62, Mediterranean and French Atlantic; Parnell, 1831: 228, Firth of Forth; Bonaparte, 1834: 51, fig. 2, Mediterranean and Atlantic coasts of France; Jenyns, 1835: 365, Britain; Yarrell, 1836: 207, fig., Britain; Valenciennes, 1836: 50(36), 309, fig., Mediterranean and Atlantic coasts of France; Lowe, 1843: 86, Madeira; Guichenot, 1850: 67, Algeria; Nilsson, 1855: 177, Norway; Günther, 1861b: 454, fig., Lanzarote, Madeira, Canary Is., Mediterranean; Steindachner, 1865: 402, Santa Cruz, Tenneriffe; 1868: 684, Spain, Portugal; Day, 1881: 232, pl. 67, Britain; Moreau, 1881: 195, French coasts; Rochebrune, 1882: 97, C. Blanco, Portendik; Canis, 1893: 708, Mediterranean; Smitt, 1893: 334, pl. 15, fig. 11, Norway; Antipa, 1909: 78, fig. 24, Roumanian Black Sea coast; Ninni, 1909: 311, Mediterranean; Lampe, 1914: 229, Ponta Delga da Azores; Boulenger, 1916: 89, fig. 52, Egypt, Madeira, Lanzarote, Canary Is.; Athanassopoulos, 1919: 265, figs 2,5,15,16, Mediterranean; Mohr, 1921: 38, North Sea; Pellegrin, 1921: 195, fig. 93, Morocco, Algeria, Tunisia; Joubin & Le Danois, 1924: 47, fig., France; Popov, 1929: 246, fig. 2, Nobre; 1935: 328, fig. 146, Portugal; Fridriksson, 1941: 151, Norway; Rossignol, 1952: 89, Monaco; Dollfus, 1953: 138, Atlantic coasts of Morocco; Perlmutter et al., 1957: 290, figs A-F, rivers of Israel; Morovic, 1957: 5, figs, Adriatic.

*Uta chelo* Popov, 1929: 246, Mediterranean; 1930: 62, fig. 3, pl. 3, figs 1-2, Black Sea.

*Chelon chelo* Schultz, 1946: 391, Mediterranean.

*Mugil curruatus* Lowe, 1839: 184, Madeira; 1843a: 155, fig., Madeira; 1860: 155, pl. 22, Madeira.

*Mugil uptonianus* Günther, 1861a: 349, Firth of Forth; 1861b: 455, fig., England, Firth of Forth, Scandinavia.

*Mugil capito* Lortet, 1883: 133, Nahr el Kelb, non Cuvier.

*Uta (Oxylechilus) provensalis* Fowler, 1903: 749, Mediterranean, non Russo.

*Mugil provensalis* Lozano Rey, 1935: 254, pl. 4, fig. 1, Spain; 1947: 736, pl. 19, fig. 3, Spain; Fowler, 1936: 594, Canaries, Fayal (Azores), Porto Grande (Cape Verde Is), Albuquerque, 1936: 605, fig. 272, Portugal, non Risso.

*Mugil Labeo* Fowler, 1936: 598 (part), Azores, non Cuvier.

TYPE. None (see Berun, 1946). Type locality, Nice.

MATERIAL EXAMINED. 176 specimens, including the types of *M. chelo* and *M. septentrionalis*, 10-410mm SL, from Greece, Israel, Egypt, Cyprus, Yugoslavia, Monaco, France, Italy, Madeira, England and Scotland. BMNH: 1856.12.10.21, 150mm, syntype of *M. septentrionalis*, London market, Yarrell; 1859.5.4.36, 312mm, Lanzarote; 1861.3.9.1, 3 spec. 307-383mm, syntypes of *M. septentrionalis*, London market, Günther; 1862.10.3.1, 110mm, Madeira; 1890.6.16.23-4, 31 & 34mm, Porto Grande; 1893.2.28.24, 182mm, Zara, Yugoslavia; 1895.5.28.55, 246mm, Madeira; 1897.16.26.71, 85mm, Ombla R., Yugoslavia; 1907.3.4.1, 200mm, Portland; 1910.4.25.2, 232mm, Bridlington Harbour; 1925.9.19.89, 174mm, Ismailia; 1928.1.21.59-61, 3 spec. 48-120mm, Thrace; 1928.8.14.72-3, 60 & 62mm, Cyprus; 1929.1.21.2, 178mm, Mavagissey; 1929.8.31.5, 130mm, Egypt; 1933.3.5.55, 143mm, Andros; 1936.12.30.31-2, 156 & 188mm, Syria, Greece; 1937.7.22.2, 180mm, Invergordon; 1937.7.22.3-6, 4 spec. 141-162mm, Invergordon; 1949.6.9.1, 143mm, Villefranche; 1949.11.2.34-5, 143 & 152mm Monaco; 1953.11.1.53-4,

156mm, Santa Cruz, Madeira; 1955.11.1.531-5, 537-46, 15 spec. 44-120mm, Funchal, Madeira; 1955.11.1.547-8, 36 & 37mm, Santa Cruz; 1954.9.20.3, 10 spec. 2-25mm, Cornwall; 1960.6.24.78, 97mm, Catalonia; 1961.12.15.38, 23mm, Bude, Cornwall; 1962.6.5.300-12, 13 spec. 48-126mm, Padstow; 1962.6.25.23-4, 130 & 168mm, Azores; 1962.7.30.751, 110mm, Port Erin; 1962.7.30.753-6, 4 spec. 176-195mm, Pollybreen, Isle of Man; 1967.6.7.45-74, 40 spec. 10-16mm, Port Hellick, Scilly Isles; 1967.10.24.80, 25mm, Tregaronn Pt. Cornwall; 1967.12.26.82, 147 & 154mm, Naples; 1970.4.21, 45mm, Plym estuary; 1971.10.7.460-1, 22 & 26mm, East Roscarberry Bay; 1972.1.26.149-155, 7 spec. 19-24mm, Ulsac, Scilly Isles. MNHN: 6400, 233mm, lectotype of *M. chelo*, Brest, Noel; A. 3588, 135 & 153mm, paralectotypes of *M. chelo*, La Rochelle, D'Orbigny; A. 3596, 4 spec. 46-59mm, paralectotypes of *M. chelo*, Lorient, Ducrest; A.3599, 220mm, paralectotype of *M. chelo*, Naples, Bibron; A.3602, 135 & 140mm, paralectotypes of *M. chelo*, Lorient, Ducrest; A.3603, 220mm, paralectotype of *M. chelo*, Mediterranean, Delalande; A.3775, 222mm, paralectotype of *M. chelo*, Abbeville, Bailion, A.4651, 355mm, paralectotype of *M. chelo*, Marseilles, coll. unknown.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 18. I 1 42-45, tr. 15, ped 9, pect. sc. 10-11, D<sub>1</sub> sc. 12-14, D<sub>2</sub> sc. 27-29. Scales pavement ctenoid, mucus canals, long, narrow and deep; occasional fish with 2 or (more rarely) 3 canals on flank and dorsal scales; some slight secondary squamation. Body slender, elongate; head pointed, scale-free to anterior nostril or slightly less; interorbital about twice eye diameter, almost flat; eye diameter about equal to snout length. Upper lip median height < 1/2 eye diameter; lower 1/4-1/3 with 2-3 rows of papillae, generally oval, but extended transversely in the lowermost row, tipped with horny ridges. Symphysial groove unusually deep, its walls pleated in large fish. Anterior mandibular pores c. 1/2 along symphysial groove and about breadth of symphysial knob apart; 4 distinct pairs behind. Teeth in 2 rows in upper lip, scattered teeth between. Row of scattered low mound-like papillae at inner base of lower lip; mouth membrane with elongate pointed papillae. Pad over tendon to mouth corner c. 1/2 as long and 1/3 as wide as pad over maxilla. Preorbital reaching 1/3 up upper lip, below line joining mid-points of posterior and anterior nostrils; posterior nostril nearer eye than anterior to lip; anterior nostril with distinct raised cutaneous rim. Gill rakers short, type 4.

Pectoral fin reaching hind edge of pupil when laid forward, reaching < 1/2 along pelvic fin (not reaching past tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical between bases of sp. 1 and sp. 3 of first dorsal fin; axillary scale not reaching tip of pelvic spine. First dorsal fin origin nearer snout than caudal base; sp. 1 longer than sp. 2; sp. 4 short, not reaching past vertical from tip of sp. 3 when fin raised; axillary scale reaching 3/4 along membrane behind sp. 4. Second

TABLE 17. Biometrics of *Chelon* spp and *Oedalechilus* spp. \* 2 rows with scattered teeth between. # obscure. Abbreviations as in Tables 2-4.

Species	<i>C. labrosus</i>	<i>C. bispinosus</i>	<i>O. labeo</i>	<i>O. labrosus</i>
Scale radii	7-9	6-8	7-8	6-7
D (%SL)	22.6-25.9	24.7-26.6	23.3-24.6	25.5-30.0
HL (%SL)	23.0-24.2	26.0-26.6	20.5-21.5	22.2-24.2
HW (%HL)	63.4-65.8	60.2-64.8	76.0-78.5	70.5-74.0
IO (%HL)	45.5-49.0	41.3-44.7	50.0-51.4	49.5-53.5
ED (%HL)	21.2-24.0	28.2-30.1	25.6-26.6	27.0-28.4
SnL (%HL)	21.0-24.0	24.3-30.2	25.6-26.6	27.0-28.4
UHL (%HL)	8.8-10.2	14.0-15.1	8.5-9.3	10.0-13.2
MW/ML	4.0	4.3-5.0	4.5-4.6	4.6-5.0
PL (%HL)	81.2-82.0	84.3-86.8	88.2-90.1	100.0-112.0
PB (%PL)	28.2-33.3	23.5-25.5	31.2-38.4	27.8-29.1
PAx (%PL)	na	na	27.1-28.4	24.7-25.5
VL (%PL)	79.0-81.0	74.3-79.7	77.5-83.3	62.3-68.8
VAx (%VL)	40.5-52.8	33.3-38.8	43.6-44.7	39.7-45.2
Ped (%D)	47.5-50.0	45.0-46.5	54.5-55.6	44.0-48.0
TR(UL)	2 +sc*	2	0	0
TR(LL)	0	0	0	0
LES	16-20	16-26	17-20	26-40
FES	5	3-7	0	10#
Sp.2/Sp.1	3.0	3.3	4.0	3.3
Sp.3/Sp.2	1.5	1.4	1.6	1.4
PC	6-7	5-6	6-7	4

dorsal fin tips of anterior rays reaching behind tips of posterior rays; anal fin higher than subequal dorsal fins; second dorsal and anal fins lightly scaled anteriorly and along base. Pyloric caeca 6-7.

DISTRIBUTION. Black Sea, Mediterranean, eastern Atlantic coasts from Cape Verde Islands northward and across to Iceland.

REMARKS. The ornamentation on the upper lip of adult *C. labrosus* distinguishes this species from all other mugilids except *C. bispinosus* and species of *Oedalechilus* and *Crenimugil* whose generic characters differentiate them. The long pectoral fin and different position of the origin of the first dorsal fin distinguish *C. bispinosus* from *C. labrosus*. These characters also distinguish the species before the papillae develop. At these small sizes the very short mouth gape of *Chelon* separates them from other species. The appearance of the ornamentation of the upper lip in museum specimens varies depending upon the state of preservation. The papillar structure is often distorted or worn away. The underlying lamellar

structure has been described by some authorities as the normal appearance of the lips. There is a series of specimens in the British Museum in which part of the lip bears the normal oval papillae and the other part displays the plicate fringing induced by wear.

The identity of *Mugil chelo* Cuvier with *Mugil labrosus* Risso was established by Trewavas & Ingham (1972). The identity of Lortet's specimens which he named *M. capito* [Lyon 2918] was determined by Trewavas (pers. Comm.).

### *Chelon bispinosus* (Bowdich, 1825)

*Mugil bispinosus* Bowdich, 1825: 236, fig.38 (Bona Vista, Cape Verde Islands); Trewavas & Ingham, 1972:22 (Cape Verde Islands).

*Mugil nigrostrigatus* Günther, 1861b:457, fig. (St Vincent, Cape Verde Islands); Troschel, 1866:219 (Cape Verde Islands).

*Liza nigrostrigatus* - Cadenat, 1954:567 (Cape Verde Islands); 1955:60 (Cape Verde Islands).

?*Mugil pulchellus*, Troschel, 1866:222, fig. (Cape Verde Islands).

*Mugil provensalis* - Fowler, 1936: 594 (Porte Grande, Cape Verde Islands) non Risso.

TYPE. Non; type locality Cape Verde Islands.

MATERIAL EXAMINED. Three specimens 90-151mm SL from the Cape Verde Is. BMNH: 1844.10.17.61, 184mm, syntype of *M. nigrostrigatus*, ?Borneo, Belcher; 1861.6.27.4, 109mm, syntype of *Mugil nigrostrigatus*, St Vincent, Admiralty; 1865.5.13.14, 90mm, Brava Is., Cape Verde Group.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 17, L1 41-42, tr. 17, ped. 9, pect. sc. 12-13, D<sub>1</sub> sc. 14-15, D<sub>2</sub> sc. 26-27. Scales pavement ctenoid on flanks, seven upper rows variably ctenoid or cycloid, breast scales ctenoid; mucus canals moderately long; some double canals on dorsal and flank scales. Body elongate slender; head bluntly pointed, scale-free to just in front of posterior nostril; interorbital >1.5 times eye diameter, almost flat; eye diameter very slightly longer than snout. Upper lip median height c. 1/2 eye diameter; lowest third or more with 5-7 rows of papillae, flask-shaped in post-querimana fish, becoming tipped with horny material in large specimens. Symphyseal knob set well back from edge of deeply recessed lower lip; symphyseal groove shallow. Anterior mandibular pores at rear of symphyseal groove, about breadth of symphyseal knob apart; a smaller pair behind, same distance apart, others obscure. Teeth at edge and inner base of upper lip. Pad over tendon to mouth corner 1/2 as long and 1/3 as wide as pad over maxilla. Preorbital buried in adipose tissue, reaching 1/2 up upper lip, on line joining mid-points of posterior and anterior nostrils; posterior

nostril nearer eye than anterior to lip; anterior nostril with slight cutaneous rim. Gill rakers short, type 4.

Pectoral fin reaching posterior nostril when laid forward, c. 1/2 along pelvic fin (not reaching behind tip of pelvic spine) when laid back. Pelvic fin tip reaching vertical from base of sp. 4 of first dorsal fin or slightly behind; axillary scale reaching < 1/2 along pelvic spine. First dorsal fin origin distinctly nearer caudal base than snout tip; sp. 1 longer than sp. 2; sp. 4 short, slender, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching 1/2 or slightly more along membrane behind sp. 4. Second dorsal fin anterior rays reaching well behind posterior rays; anal fin higher than second dorsal fin and both higher than first dorsal fin; second dorsal and anal fins lightly scaled anteriorly and along base. Pyloric caeca 5-6.

DISTRIBUTION. Cape Verde Islands.

REMARKS. Trewavas & Ingham (1972) argued that *M. bispinosus* of Bowdich is identical with *M. nigrostrigatus* of Günther. Other authors have recognised a thick-lipped mullet from the Cape Verde Islands which is the type locality of *M. bispinosus*.

Günther expressed doubt at the reported locality of Borneo for one his 2 specimens of *M. nigrostrigatus*. The other he accepted as coming from St Vincent in the West Indies, but Troschel (1866) expressed his belief that the reference was to Sao Vicente in the Cape Verde Islands. A specimen of 90mm SL in the British Museum from Brava Island, one of the Cape Verde group, is identical with the types of *M. nigrostrigatus*. The dentition of *M. pulchellus* Troschel (1866) indicates that it is probably *C. bispinosus* and not *M. capurrii* as Steindachner (1882) and Fowler (1936) suggested (though misidentifying that species as *M. curvidens*).

#### **Oedalechilus** Fowler, 1903.

*Oedalechilus* Fowler, 1903: 748; type species: *Mugil labeo* Cuvier, 1829.

*Plicamugil* Schultz, 1953: 315; type species *Mugil labiosus* Valenciennes, 1836.

DIAGNOSIS. Mouth gape horizontal, mid-gape and mouth corner at mid-eye level, mouth corner reaching to vertical slightly in front of anterior nostril, or between nostrils; tip of upper jaw well below line of gape, reaching vertical slightly behind posterior nostril and c. 1/3 eye diameter below lower rim of eye. Upper lip terminal, high; row of papillae below groove near lower edge;

lower lip thick, turning down, edged with papillae, recessed in front of high double symphyseal knob; wide symphyseal groove shallow; no lip groove; no fleshy lobes over ends of jaws or lying freely between lower jaw rami. Maxilla mobile, tendon flange well down shaft, below level of mouth corner; shaft curving down and out below short almost horizontal median section, its lower end S-shaped and covered by pad visible below mouth corner when mouth closed; lower jaw almost straight, curving only near mouth corner. Mandibular angle obtuse. Lips edentate, teeth variably developed on vomer and palatines, always on pterygoids and tongue; tongue flat with median ridge. Adipose tissue rim around eye; preorbital deeply notched, posteriormost point of notch behind vertical from anterodorsal corner of the preorbital; obsolescent serrae on front edge. Nostrils nearer each other than eye or lip; anterior nostril within vertical span of posterior nostril; anterior nostrils with high cutaneous rim.

Upper insertion of pectoral fin at level of upper 1/4 of eye; axillary scale small; first dorsal fin origin variably nearer caudal base or snout tip. Second dorsal fin origin at verticals 2/5-1/2 along anal fin base; caudal fin moderately forked. Scales pavement ctenoid, head scale-free to anterior nostrils; no spine on edge of operculum; 3 anal spines in adults. Stomach with a gizzard; intestine 4-6 times SL. Pyloric caeca 4-7.

REMARKS. Fowler introduced *Oedalechilus* as a subgenus of *Liza*. Although the type species was *O. labeo* he included *O. provensalis* (= *C. chelo*), regarded here as a species of *Chelon*. Schultz (1946) united *Mugil labeo* and *Chelon labrosus* (as *Chelon chelo*) in his concept of *Chelon*. The reference by Arty, on whose authority *Chelon* is based, included reference to both *Chelo* (or *Chelon*) and *Labeo* in various pre-Linnean authors. Trewavas & Ingham (1972) indicated the difficulty in deciding whether these names were synonymous. As distinguished here the species are sufficiently different to be assigned to separate genera.

The deep notch of the preorbital is a distinctive feature of *Oedalechilus*. The great width/length ratio of the mouth distinguishes it from all but *Chelon*, from which it differs in the deeply-notched preorbital, flat tongue, level of the mouth corner, mobile maxilla, edentate lips and nature of their ornamentation.

#### KEY TO THE SPECIES OF *OEDALECHILUS*.

1. Scales 48-52 in longitudinal series; single pair of 'shelves' inside mouth corner (Mediterranean)

Scales 34-36 in longitudinal series; 4 pairs of 'shelves' inside mouth corner (Indo-Pacific) . . . . *labiosus*

### ***Oedalechilus laleo* (Cuvier, 1829)**

*Mugil provencalis* var A Risso, 1811: 346, Nice.

*Mugil provençal* Risso, 1826: 39, Nice; Bonaparte, 1834: 30, fig. 2, Italy; Jenyns, 1835: 375, Britain.

*Mugil laleo* Cuvier, 1829: 233, Monaco, Nice, Villefranche, Banyuls, Calde, Mediterranean; Valenciennes, 1836: 55(40), fig. 310, Mediterranean; Günther, 1861b: 453, Mediterranean; Steindachner, 1868: 682, Santa Cruz; Fowler, 1936: 596, fig. 272, Fayal, Azores; Lozano Rey, 1947: 740, pl. 19, fig. 4, Spain; Morovic, 1957: 5, Adriatic.

*Mugil (Oedalechilus) laleo* Fowler, 1903: 748 (subgen. nov. for *M. laleo*); Cabo, 1979: 220, fig. 82.

*Liza laleo* Popov, 1930: 87, pl. 4, Figs 2-3, San Jago, Palerm; Cadenat, 1954: 567, Corsica; 1955: 60, Corsica; Dieuzeide et al, 1955: 244, Algeria.

*Oedalechilus laleo* Tortonese, 1972: 34, Genoa, Naples; Bauchot & Pras, 1980: 300, fig. 27f, Mediterranean.

TYPE. Lectotype: Mediterranean, Delalande MNHN A.3606.

MATERIAL EXAMINED. Types and 33 specimens, 76-360mm SL from Monaco, Nice, Villefranche, Banyuls, Catelana and unspecified places in the Mediterranean. BMNH: 1949.11.2.1-10, 10 spec, 107-203mm SL, Monaco; 1949.11.2.30-33, 4 spec, 123-144mm, Villefranche; 1960.6.24.79-97, 18 spec, 137mm, Catalonia; 1963.5.14.488, 222mm, Banyuls. MNHN: A.3606, 167mm, lectotype of *M. laleo*, Mediterranean, Delalande; A.3607, 140mm, paralectotype of *M. laleo*, Nice, Savigny; A.4654, 360mm, paralectotype of *M. laleo*, Mediterranean, Delalande.

DESCRIPTION. D<sub>1</sub> IV, D<sub>2</sub> i 8, A III 9, P 18-19, L1 48-52, tr 15, ped. 9, pect. sc. 12, D<sub>1</sub> sc. 16-18, D<sub>2</sub> sc. 31-33. Scales with mucus canals of variable length, lacking on most flank scales; no multicannaliculate scales. Body elongate, slender; head bluntly pointed; interorbital almost twice eye diameter, very slightly convex; eye diameter equal to snout length. Upper lip thick, median height >1/3 eye diameter; single row of papillae developing into horny fringe, close-packed viewed horizontally with each element 3 times as high as wide, viewed from above or below a narrower stem supports each element; lower lip crenulate, sheathed in horny material; shelf-like fold with horny covering inside each corner of the mouth. Anterior mandibular pores at rear of symphyseal groove, about breadth of symphyseal knob apart. Teeth on pterygoids and tongue, none on palatine or vomer; tongue flat, slightly domed at rear, unusually broad anteriorly; mouth membrane with elongate pointed papillae. Mouth corner on vertical c.3/4 from snout tip to anterior nostril; maxilla tendon flange 2/3 down shaft, below mouth corner; upper 1/3 of maxilla shaft almost horizontal, curving down at somewhat more than a right angle to behind mouth corner, thence back to tendon flange and then an S-curve to end

of shaft; maxilla not visible above premaxilla but visible below mouth corner when mouth closed; pad over tendon to mouth corner only 1/2 as long and 1/3 as wide as pad over maxilla. Preorbital not quite filling space lip to eye; reaching 1/2 up upper lip, slightly below line joining midpoints of anterior and posterior nostrils; posterior nostrils extending above level of upper rim of eye. Gill rakers long, type 4.

Pectoral fin reaching anterior iris when laid forward, c.1/2 along pelvic fin (not to tip of pelvic spine) when laid back. Pelvic fin origin nearer vertical from origin of pectoral fin than that from first dorsal fin origin, its tip reaching vertical from sp. 1 of first dorsal fin in fish <180mm SL not so far in larger fish; axillary scale not reaching tip of pelvic spine. First dorsal fin origin equidistant from caudal base and snout tip; sp. 1 shorter than sp. 2; sp. 4 slight, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching c.1/3 along membrane behind sp. 4. Second dorsal fin origin at vertical 2/5-1/2 along anal fin base; tips of anterior rays not reaching behind tips of posterior rays; anal fin higher than second dorsal fin and both distinctly higher than first dorsal fin; second dorsal and anal fins lightly scaled anteriorly. Pyloric caeca 6-7.

DISTRIBUTION. W Mediterranean to the Azores.

REMARKS. *O. laleo* is distinguished from *O. labiosus* in the key and by the number of pyloric caeca, details of the lip ornamentation and by their geographic separation. Although *M. provencalis* Risso (1826) predates *M. laleo* Cuvier (1829), it can only be regarded as a variant spelling of *M. provencalis* of Risso (1810) which was a synonym of *M. cephalus* as indicated by Trewavas & Ingham (1972).

### ***Oedalechilus labiosus* (Valenciennes, 1836)**

*Mugil labiosus* Valenciennes, 1836: 125(92) Red Sea; Bleeker, 1854b: 213, Timor; 1859a: 278, Indonesian archipelago; 1860c: 33, Sumatra; 1860d: 55, Borneo; 1860e: 6, Celebes; Günther, 1861b: 454, Timor, Red Sea, Sumatra; Klunzinger, 1870: 830, Red Sea; 1884: 133, pl. 10, fig. 4, Red Sea; Day, 1876: 367, Andaman Is; Weber, 1895: 262, Ambon; Weber & De Beaufort, 1922: 259, Sumatra, Simalur, Timor, Ambon, Biaru, Salibabu; Fowler, 1927b: 262, Philippines; 1928a: 126, references; Roxas, 1934: 422, Philippines.

*Liza labiosa* Fowler, 1918: 62, Philippines.

*Pliconugil labiosus* Schultz, 1953: 320, figs 49-50, Bikini, Reer Is.; Pillay, 1962: 267, Andaman Is.

*Oedalechilus labiosus* Randall, 1983: 94, fig., Red Sea; Masuda et al, 1984: 120, pl. 105, fig. F, Japan; Shen, 1994: 440, pl 138, fig. 5, Taiwan.

*Mugil joloensis* Seale, 1909: 500, pl. 4, Philippines. Roxas, 1934: 421, Philippines.

*Liza jolensis* Herre, 1953: 231, Philippines

TYPE: 4 syntypes: MNHN A3616, A3617, Red Sea, Roux.

MATERIAL EXAMINED. 4 syntypes and ca 22 specimens. 61–180mm SL, from the Red Sea and Thailand. BMNH: 1871.7.15.10, 180mm, Red Sea; 1935.10.21.16–18, 3 spec. 61–72mm, Pulau Lela, Thailand, 1951.1.16.613–4, 94 & 104mm, Gulf of Aqaba; 1961.1.1.615–20, 6 spec. 89–128mm, Gulf of Aqaba; 1960.3.15.1707–15, 9 spec. 47–75mm, Khor Shihab, Sudan. MNHN: A.3616, 116 & 124mm, syntypes of *M. labiosus*, Red Sea, Roux; A.3617, 120 & 131mm, syntypes of *M. labiosus*, Red Sea, Roux. AM: IB421, 168mm, Melville Is. USNM: 154084, 37–40mm, Port Caltion, Philippines.

DESCRIPTION. D: IV D<sub>2</sub> 18, A III 9, P 17, L 134–36, tr. 12, ped. 7, pect. sc. 10–11, D<sub>1</sub> sc. 12–13 D<sub>2</sub> sc. 24–25. Scales with moderately long mucus canals; some on flank with double canals. Body moderately robust; head bluntly pointed; interorbital somewhat less than twice eye diameter, slightly convex. Eye diameter slightly longer than snout. Upper lip median height  $> 1/3$  eye diameter; single row of papillae on lip edge developing into horny fringe, adjacent elements not touching as viewed along long axis of body; stems wider than distal portions; distal elements with deep grooves, appearing almost 2-pronged when viewed from above. Lower lip thick with crenulated horny edge turned down. Within mouth complex shelf-like folds with crenulated edges; median fan-shaped pair almost meeting at mid-mouth; another more lateral pair overlapping these; at each mouth corner 2 smaller folds. Anterior mandibular pores at rear of symphyseal groove, rather more than symphyseal knob breadth apart; 4 pairs of smaller pits behind. Teeth on vomer, pterygoids, palatines and tongue. Mouth corner on vertical between anterior and posterior nostrils. Maxilla mobile, its tendon flange  $3/4$  down shaft; upper  $1/3$  descending almost vertically to level of preorbital notch, thence curving out and down. Maxilla not visible above premaxilla, but visible below mouth corner when mouth closed. Pad over tendon to mouth corner  $1/2$  length and  $1/3$  breadth of pad over maxilla. Preorbital filling space lip to eye; reaching almost to top of upper lip, well above line joining midpoints of posterior and anterior nostrils; posterior nostrils reaching slightly above level of upper rim of eye; posterior nostril nearer eye than anterior to lip. Gill rakers short, type 4.

Pectoral fin reaching between anterior rim of eye and anterior nostril when laid forward, c.  $2/3$  along pelvic fin (past tip of pelvic spine) when laid back. Pelvic fin markedly nearer vertical from origin of pectoral than that from the first dorsal fin origin; tip not reaching vertical from ori-

gin of first dorsal fin; axillary scale not reaching tip of pelvic spine. First dorsal fin origin nearer caudal base than snout tip; sp. 1 longer than sp. 2; sp. 4 short, slender, not reaching behind vertical from tip of sp. 3 when fin raised; axillary scale reaching  $> 3/4$  along membrane behind sp. 4. Second dorsal fin origin at vertical  $3/4$  along anal fin base; tips of anterior rays reaching behind tips of posterior rays; anal fin slightly higher than second dorsal fin, both higher than first dorsal fin; second dorsal and anal fins densely scaled. Pylo-ric caeca 4.

DISTRIBUTION. Indo-Pacific, Red Sea to the Philippines; not reported from African coasts outside the Red Sea; recorded only from Melville Is (N of Darwin) in Australian waters.

REMARKS. The features that distinguish *O. labiosus* from *O. laeo* have been discussed under the latter species.

#### SPECIES INQUERENDA

*Mugil acutus* Valenciennes, 1836: 140(104). As originally described is not inconsistent with *Myxus elongatus*, having 9 anal rays, 12 radii in the scales and a pointed head; but the brief description could equally fit *Liza argentea*, *L. subviridis* or *Aldrichetta forsteri* which all occur in Australian waters. Valenciennes distinguished *M. acutus* from these species which indicates a probability that it was *Myxus elongatus*, but it is listed by Valenciennes as the second species named after a statement that the following species have the maxilla visible behind the mouth which would not be true of either *Myxus elongatus* or *Aldrichetta forsteri*. The type specimen cannot be found.

*Mugil brasiliensis* Spix and *Mugil gaimardianus* Desmaret have been referred to in discussion of *M. curema*. For the sake of stable nomenclature these names should be suppressed.

*Mugil camptosiensis* Castelnau, 1861: 48. Boulenger (1916) placed this species in the synonymy of *M. cephalus*, but the few characteristics described do not differentiate it from other mugilids in the type locality.

*Dajaus choirohynchus* Hill, 1855: 143. A Jamaican species, this may be identical with *Joturus pichardi*, but the description is too slight for certain identification.

*Mugil chilensis* Molina, 1766: 272. Eschmeyer (1990) has followed Rosa & Rosa (1987) in accepting that Molina had based his species on a mugilid despite his statement that it had only 1 dorsal fin. This seems likely for 2 reasons: firstly Molina stated that it was very like the *cephalus* of

Europe, and he also said that the fish was known locally as 'lisa', a term widely used in S America for a grey mullet. Lacépède, (1803: 393) had assigned the species to *Mugiloides* the best known member of which Rosa & Rosa (1987) stated validly belonged to the non-mugilid *Pingupe*, Rafinesque (1815: 88) had offered *Myxonim* as an alternative to *Mugiloides* to contain *M. chilensis*. Valenciennes (1836) criticised Lacépède's assignment of *M. chilensis* to *Mugiloides*, accepting it as a *Mugil* and discounting the claim for only 1 dorsal fin. Ignoring Molina's claim for only 1 dorsal fin, the remainder of Molina's description could apply to any mugilid of the region.

*Mugil curtus* Yarrell, 1836: 210 was described as having 8 anal rays which could only indicate *Mugil cephalus* amongst European mullet. However Günther (1861b) and subsequent authors could not locate the specimen which was only 2 inches long. Some doubt therefore remains on whether Yarrell's fin count was correct.

*Mugil gymnocephalus* Swainson, 1820: 234 is a *nomen nudum*, although it has been listed by Chaudhuri (1917) and other non-systematic workers in India.

*Mugil longicauda* Guitart & Alvarez-Lajonchère, 1977: 3. In its general form this species resembles *M. curvidens* Valenciennes, particularly in the elongate caudal peduncle and the lack of a pectoral axillary scale, both conditions not found in any other member of the genus. Both species have densely scaled second dorsal and anal fins. But *M. longicauda* was reported to have 9 anal rays, whereas *M. curvidens* has 8. However, Valenciennes counted the rays of *M. curvidens* as 9. Otherwise the only differences are in body proportions. Guitart & Alvarez-Lajonchère's specimens were >300mm, whereas *M. curvidens* reported upon here were only 32-94mm SL. Body proportions change with size in Mugilidae. The coincidence of 2 species occurring together with the unique combination of elongate caudal peduncle and lack of pectoral axillary scale would be remarkable. Consequently, pending an examination of a specimen, *M. longicauda* is listed here as uncertain.

*Myxus malayanus* Herre, 1936a: 286. The description is inadequate. It is unlikely to be a *Myxus*, but neither its generic nor specific identity can be determined.

*Mugil natalensis* Castelnau, 1861: 50. Boulenger (1916) placed this species in the synonymy of *Liza dumerili* (his *Mugil aurata*). However Castelnau's description could also apply to

*Trachystoma euronotus* which also occurs in the type locality.

*Myxus pacificus* Steindachner, 1901: 500. This was possibly a young *Chaenomugil leuciscus*, but the description is inadequate.

*Mugil parva* Oshima, 1922: 253 was referred by Fowler (1935) to *L. ceramensis* (= *macrolepis*); but Oshima described his fish as having the maxilla hidden, no adipose eyelid and 33 lateral scales.

*Mugil tang* Bloch, 1788: 134, pl. 135. This species is inadequately described and poorly illustrated. Jordan & Seale (1907) suggested this was *Mugil cephalus*, but the few descriptive details do not tally. Cuvier (1830) may have been correct in attributing it to *Liza aurata* (it was coloured gold in Bloch's illustration) but Bloch's description could apply to other W European mullet.

*Mugil tehu* Curtiss, 1938: 47, Tautira, Tahiti. Fowler (1928a) placed this species in the synonymy of *Valamugil cunnesius* (his *Mugil longimanus*). However the original description could equally apply to other species of *Valamugil*.

*Mugil tasmanicus* Castelnau, 1872: 141. This name appears in the text, apparently, though not explicitly stated, as a new name for *Dujins diemensis* Richardson.

*Mugil tranquebar* Lacépède, 1803: 388. The name was listed without description and attributed to Bloch. It appears to be a *nomen nudum*.

*Myxus trimaculatus* Klunzinger, 1870: 832. This Red Sea species was not described well enough to discriminate between several species of mullet found in the area. Mohr (1927) apparently had Klunzinger's types, but her description is no more helpful. The types were apparently destroyed during the second World War. The name should probably be suppressed.

## EVOLUTIONARY RELATIONSHIPS

The most primitive mullet may be assumed to have had a simple sac-like stomach, a short intestine and a minimum number of pyloric caeca. A thick lip with sessile teeth are other likely features. Teeth on the palatal bones would be likely but there would be few specialised structures such as adipose eyelids, lip ornamentation and complexly curving maxillae. The only extant genera which fully comply with this picture of a primitive mullet are *Agonsotomus* and *Joturus* of which the latter demonstrates one peculiarity, a snout which overhangs the mouth as well as an unusually short free edge to the operculum. *Oestractus* also displays most of the primitive features but it has the fleshy labial palps in the form of



free-ending lobes over the ends of the jaws and lying freely between the rami of the lower jaws. This genus also has the peculiarity of having the end of the upper jaw above the line of the gape, a characteristic shared only by *Chaenomugil*. From this it may be concluded that *Agonostomus* is the most primitive living mugilid. This genus with *Joturus* and *Cestraeus* differ from the more highly evolved genera in having few relatively coarse gill rakers, a flat preorbital without ridging and not notched, only 2 anal spines in the adults and sessile teeth in the jaws. The transition from these primitive genera to more advanced genera is associated with the formation of a gizzard-like stomach, a lengthening of the intestine, a thinning of the lower lip and appearance of a symphyial knob raised above the general surface of the lip. The preorbital becomes grooved with a ridge diagonally across it and a notch develops on its front edge. This is associated with a major development of the facial anatomy with the anterior-posterior extent of the mouth opening shortening and the mouth corner moving from below the eye to in front of it. The preorbital notch developed to accommodate the mouth corner; at the same time the adductor tendon attached lower down the maxilla shaft which curves outwards to accommodate the passage of the tendon. The upper part of the maxilla lost its firm attachment to the skull and the mouth became protrusible. The third anal fin element became a spine, though only after the early querimana stage. The interorbital flattened and the eye came closer to the dorsal profile of the head or even above it in the genus *Rhinomugil*. There are genera which are intermediate between the primitive genera and the most advanced. These are *Aldrichetta* which is usually assigned to the more primitive Agonostominae despite having some of the more advanced characteristics, and *Myxus* which is usually placed in the Mugilinae. In these genera the intestine is of intermediate length. The gizzard, though distinct, is not as well developed as in the typical Mugilinae. The symphyial knob is low in *Aldrichetta*, but high in *Myxus*. The gill rakers are longer and not as coarse as in the typical Agonostominae, but not as fine as in the typical Mugilinae. Species of *Chaenomugil* are more advanced than *Myxus* in that the adductor tendon attachment has descended to almost halfway down the maxilla, but like *Myxus* this genus has not acquired the adipose tissue around the eye which is characteristic of advanced Mugilinae. As in *Chaenomugil* the adductor attachment in *Mugil* is halfway down the maxilla shaft which is almost straight in its upper half, but curving gently in one

plane to the tip of the upper jaw in the lower half. There are no teeth on the vomer and palatine of *Mugil* and adipose tissue is well-developed, covering most of the iris and often part of the pupil. *Sicamugil* is closely allied to *Mugil* in the position of the attachment of the adductor to the maxilla and in the absence of teeth on the palate bones; but its adipose tissue is not well-developed.

*Valamugil* is similar to *Sicamugil* in having an exposed pad below the mouth corner, at least in some species. But the pad is single and lies over the tendon to the mouth corner. In *Liza*, *Chelon* and *Oedalechilus* the pad is double; the posterior, and usually larger pad overlies the maxilla and the slighter anterior pad covers the adductor tendon. In *Valamugil* the tendon attachment is below the halfway point on the shaft of the maxilla. In the remaining genera the tendency to attach lower on the maxilla shaft increases and with it the maxilla curves outward to provide the tendon with a direct line of action, as well as curving back and down to the end of the upper jaw, thus curving in 2 planes rather than the 1 evident in *Mugil* and *Sicamugil*. *Rhinomugil* is aberrant in having the eyes on top of the head to allow aerial vision, in the nature of its snout and in the unusual position of the nostrils, though these are probably a result of the aerial vision which necessitates lifting the head high in the water. The general features of the genus suggest that it is related to *Mugil* or possibly descended from an ancestor intermediate between *Mugil* and *Valamugil*. *Rhinomugil* has ctenoid scales, a primitive feature, but the adductor tendon is attached more than halfway down the maxilla shaft and it has a very short lip groove like that in *Valamugil*. Lip ornamentation indicates that *Crenimugil* is a specialised genus. Although the maxilla curves in 2 planes, there is no exposed maxilla pad below the mouth corner as in *Liza*.

In its fimbriate scales, elongate axillary scales etc. *Crenimugil* is similar to *Valamugil* rather than to *Liza* or the other genera with papillate lips. In the remaining genera a lip groove is not present; the depth of the mouth gape is short. In *Liza* the adductor attachment is 2/3 down the maxilla shaft. The palate teeth are well developed. In some species the vomers, palatines, and pterygoids all have teeth, in others one or more. Usually the vomer and palatines, may be without teeth. As *Mugil* and *Valamugil* lack teeth on the vomer and palatines, this suggests that *Liza* is derived from some common ancestor and not from either of these genera which in other ways are more primitive than *Liza*. The scales of *Liza* are

also variably ctenoid, pavement ctenoid or cycloid whereas they are pavement ctenoid in *Mugil* and the degree of development of adipose tissue varies widely in *Liza*. Despite their lip ornamentation *Chelon* and *Oedalechilus* are not otherwise anatomically close to *Crenimugil*, but display many features in common with *Liza* and are doubtless derived from this genus.

This evolutionary series (Fig. 1) differs in important respects from that offered by Schultz (1946). The nature of the scales seems to be more related to ecomorphic correlations than to evolutionary relationships as Schultz considered. Those species which spend much time in fresh water tend to have ctenoid scales, those which seldom, if ever, enter freshwater tend to have cycloid scales. *Cestraeus* was regarded by Schultz as an end product of evolution through *Mugil* and *Chaenomugil*. But in its general characteristics it is so primitive that it must be close to *Agonostomus* and *Joturus*. When the gut features and jaw arrangement are considered *Myxus* must be regarded as more primitive than *Mugil* rather than a derivative from it as indicated by Schultz. Similarly *Chaenomugil* displays features which in general are more primitive than those of *Mugil*. Probably *Chaenomugil* and *Myxus* evolved separately from a common ancestor as each has features more primitive than the other and each features that are more advanced than the other. Schultz regarded *Rhinomugil* as branching from the line of descent before the evolution of *Mugil*. But the general features of the genus, apart from its specialised adaptations, are in many respects nearer *Valamugil* or *Liza* than *Mugil*. The progressive change in jaw structure and associated facial arrangements to which Schultz (1946) first drew attention are correlated with increasing protrusibility of the mouth. A parallel change is seen in young mugilids growing from post-larval to querimana to juvenile to adult stages. This is correlated, at least in part, with a change in diet from a planktonic to a benthic and iliophagous diet. Study may well reveal that a phylogenetic change in feeding habits is associated with structural adaptation of the mugilid mouth.

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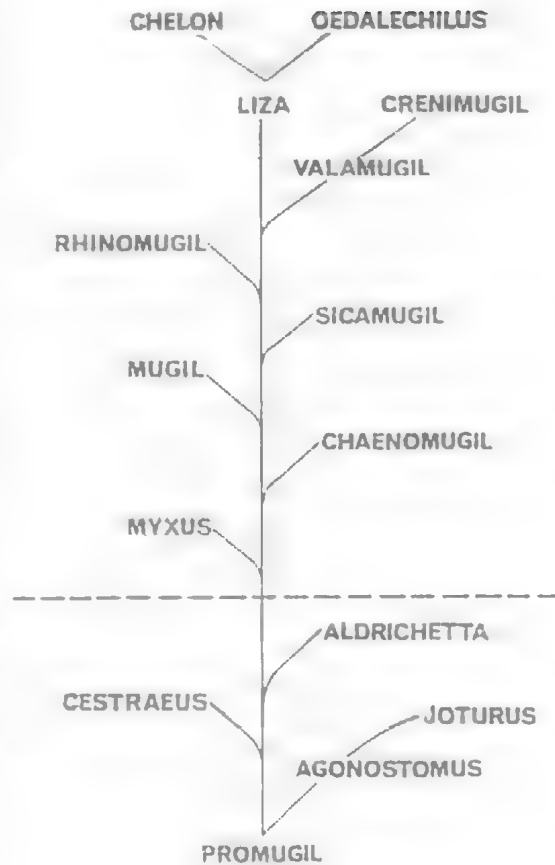


FIG. 1. Evolutionary scheme for Mugilidae. Dashed horizontal line indicates Mugilinae (above) and Agonostominae (below).

Museum, Indian Museum, Naturhistorisches Museum in Vienna, Rijksmuseum van natuurlijke Historie, Leyden, Zoologisches Institut und Zoologisches Museum, Hamburg and the Laboratoire Arago at Banyuls-sur-mer. Gratitude for lending type specimens is extended to the directors of the Bernice P. Bishop Museum, the Natal Museum, the South African Museum, and the United States National Museum.

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